

HORTICULTURAL ABSTRACTS.

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Abstracts. Initialled abstracts in the present number are by N. Esbjerg (Blangsted Experiment Station, Odense, Denmark), J. Hearman, W. A. Roach and H. Shaw.

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Horticultural Abstracts

Vol. V

September, 1935

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HORTICULTURE—MISCELLANEOUS.

327.

ANON.

641/2

More food from the farmer.*The Times*, July 29th, 1935.

Evidence is brought to show the pronounced improvement in human health brought about by an increased consumption of the "protective foods", namely milk, fresh vegetables, fruit and eggs. Many countries have recently initiated large scale experiments in nutritional feeding and the results obtained in every case are here described as "startling". It is shown too that in many cases where improved housing has involved a greater expenditure on rent and a consequent reduction in the family budget of the amount available for food, health has suffered rather than gained by the change. From this it is argued, and Governments are now becoming alive to the fact, that increased production rather than restriction of agricultural produce should be the aim. The prosperity of agriculture always reacts favourably on the prosperity of industry and every effort should be made to extend agricultural markets. The farmer instinctively desires to farm well and produce to his utmost capacity and agricultural science has shown that the world can produce far larger yields without any considerable extension of area or increase of cost. It is emphasized, however, that it is not so much an increased consumption of easily preservable foods such as wheat, sugar, dairy products or meat that is required, as of the fresh perishable protective foods already mentioned. A concerted move by Governments to increase the consumption of food of this nature would be a certain way of restoring world trade and prosperity and the deliberate association of the problems of agriculture and health presents a satisfactory line of advance. [This subject was later raised by the Rt. Hon. S. M. Bruce, High Commissioner for Australia, at Geneva and by the Rt. Hon. J. A. Lyons, Prime Minister of Australia, at Rome.—ED.] That the people of Great Britain are becoming alive to the benefits to be derived from at least one of these commodities when it is available at a reasonable price is shown in the supplement to the *Annual Survey of Fruit Supplies in 1934* prepared by the Imperial Economic Committee. In 1934 the record consumption of nearly 2,000,000 tons of fresh fruit was attained and it is stated that this was mainly due to the exceptionally heavy crops of apples. Even so, however, about three-quarters of the supplies available are imported from overseas, though it is satisfactory to learn that 46 per cent. of the imports came from Empire countries as compared with 41 per cent. in 1933 and only 20 per cent. in 1919-23.

328.

HUTCHINSON, H. P.

634.973.623

The basket willow crop.*Annu. Rep. Long Ashton Res. Sta. for 1934, 1935*, pp. 264-71, bibl. 1.

The object of this paper is to emphasize points of particular scientific interest which have appeared during the past ten years in the experimental and advisory work at Long Ashton. The most suitable sites for willows are those areas which verge on the water limits of cultivation. The chief factor affecting growth is an ample water supply, but in this connection it is important that the water should be continually in a state of movement. The lack of aeration at the roots due to stagnant water always seriously checks growth. Willows grown experimentally in tap

water made much better growth than those grown in water that had previously been boiled. There are considerable varietal differences between basket willows. A rod of suitable size which can be easily twisted or bent with a minimum of fracture is desirable. The reasons for pliability have not been properly studied yet but this character appears to be associated with differences in the composition of cell walls. Branched rods are undesirable and are due to variety, injury, and too much light usually caused by wide spacing or neglect to fill in gaps. No lateral branching occurred in culture experiments at Long Ashton when potassium was omitted from the nutrient solution. The relationship between length and thickness is a varietal character. The diameter should be uniform, that is, the taper should be as gradual as possible. In the peeling stage the following points are of physiological interest. A rod will peel in the upper part several days before the butt is ready. Cold periods following warm ones will cause retardation of cell activities and render the rods unpeelable. It was found possible to peel rods two months earlier than normal for any of 25 varieties by placing the rods in a greenhouse with a temperature of 50°-60° F. in January. The finest white rods are produced by *Salix triandra* varieties, *S. purpurea* being less satisfactory. Buff rods are prepared by peeling rods which have been boiled for several hours. *S. triandra* varieties give a dark buff, *S. viminalis* varieties a pale buff. *S. purpurea* ordinarily requires 2 or 3 weeks' exposure to sunlight before the required colour is obtained, but experiments at Long Ashton have shown that this time can be shortened to a few minutes by the application of a mild alkali, such as lime or washing soda. The buff colour may be affected by the soil in which the willow is growing. In the case of Black Maul, a *triandra* variety, clays and marls produce a good buff whereas peat fails to colour it. Insect and fungus pests are serious and require further research. Propagation is effected by cuttings from one- or two-year-old rods made 10-18 inches long and planted during the winter. Older rods often fail to grow. In a wet season following planting the cuttings taken from the upper part of the rods form stronger plants than those from lower down. If the season should be dry, the reverse is the case. Cultivation consists mainly in the suppression of undesirable weeds. Seedlings are being raised at Long Ashton under conditions of controlled breeding with a view to improvement in a number of directions. Economic conditions are not discussed, but it is mentioned that the lack of scientific investigation is probably causing great losses to the industry.

329. TRUFFAUT, G., AND PASTAC, I. 631.8
 Les engrais chimiques modernes. (**Modern chemical fertilizers.**) *Reprint*
Rev. Chim. industr., 1935, Nos. 517-20, pp. 32, bibl. 32.

In countries where labour is expensive and where a high yield per acre is required a complete, quickly soluble, combined fertilizer is preferable to any other, that is to say nitrogen, phosphoric acid and potash in suitable proportions. In neutral or acid soils the first principle is to produce alkalinity. If only one of the above three elements is to be used, the supply of phosphoric acid is of chief importance. Supplying either nitrates or potash alone is of little value. In binary combinations the best results are obtained from phosphoric acid and potash, nitrogen and potash come second in value and nitrogen and phosphoric acid third. These statements are supported by recent data published by a number of workers whose names will be found in the bibliography.

330. AAMODT, O. S. 577.41
A machine for testing the resistance of plants to injury by atmospheric drought.
Canad. J. Res., 1935, 12 : 788-95, bibl. 4.

This machine consists of a glass chamber with a capacity of 40-50 six-inch pots through which is forced air that has been treated by thermostatically controlled electric heaters. Dampers and baffles are provided to control the flow of air and to reduce eddies. After exposure for 8-15 hours at 110° F., 14 per cent. relative humidity, and an air velocity of six miles per hour, wheat varieties known to be drought resistant in the field showed less injury from drought than varieties known to be non-drought resistant. [Author's summary.]

331. YOUNG, R. S. 631.8

Certain rarer elements in soils and fertilizers and their role in plant growth.

Mem. Cornell agric. Exp. Sta., 174, 1935, pp. 70, bibl. 237.

This bulletin is particularly valuable by reason of its extensive bibliography of modern work on the occurrence and functions of the rarer elements in plant life. In addition an account is given of experiments recently carried on in the same field of work. Some 53 samples representing the major types of fertilizers used were collected and analysed by standard chemical and spectrographic methods. Emphasis was laid on the elements now definitely thought to be essential and on those occurring often in the fertilizers. The effect of adding the impurities found to other pure nutrient solutions was then tested on various annual crops such as oats, timothy, etc. These experiments are fully described.

332. EATON, F. M., AND BLAIR, G. Y. 631.541 : 581.192

Accumulation of boron by reciprocally grafted plants.

Plant Physiol., 1935, 10 : 411-24, bibl. 9.

The accumulation of boron in plants varies from species to species. It is influenced by grafting the plant on to a foreign root system, thus when a species which normally accumulates much boron is used as a rootstock for a species normally accumulating less boron, a greater boron accumulation is induced in the scion by the rootstock, and *vice versa*. Boron accumulates mainly in the leaves. When damage results from too much boron, it occurs first at the edges of the leaf and later spreads between the veins and shows itself first as a yellowing, and later as a browning, of the leaf. The accumulation also is greatest in the leaf edges, next in the interveinal areas and least in the veins and petioles. W.A.R.

333. WITHROW, R. B. 581.45

A photo-electric device for the rapid measurement of leaf area.

J. agric. Res., 1935, 50 : 637-43.

A technical description is given of a new photo-electric device, which makes possible the rapid measurement of the areas of leaves. The apparatus under discussion is only suitable for detached leaves, but the author considers that it should be possible to adapt the same principles without much difficulty, so as to design a small portable unit for measuring leaves on the plant.

334. JONES, L. H., AND HASKINS, H. D. 581.144.2

Distribution of roots in porous and non-porous plant containers.

Plant Physiol., 1935, 10 : 511-9, bibl. 7.

It was desired to obtain information on the top : root ratios of plants grown in porous clay pots compared with those grown in non-porous containers. The material consisted of 60 3-inch clay pots and 60 glass tumblers holding the same volume of soil as the pots, each planted with a tomato seedling. The containers were watered daily and checked every alternate day in order to maintain an even moisture content of the soil. It was found that the clay pots required twice as much water as the tumblers. At the end of thirty-three days the roots in the clay pots were massed against the sides and the plants were becoming pot bound. The roots in the tumblers were evenly distributed through the soil mass. Fully as good plants were produced in the tumblers, though the root system was slightly smaller; in fact the total weight of the plants in tumblers, roots and tops combined, was somewhat greater than in the clay. Evidence is brought to disprove the popular idea that the massing of roots at the sides of the pots is due to an endeavour to obtain the air which is (erroneously) supposed to pass through the porous pots. In cement pots, where the pore spaces are so large that there is no capillary movement of water through the pot, there is no massing of roots at the sides. The porous pot not only absorbs moisture but provides a means of moving soil moisture into the air through the wall of the pot. With the water travel the soluble salts in the soil and this results in a concentration of nitrogen around the sides of the pots and also in the pot walls. The tendency of greatest root formation

to occur where the greatest supply of nutrient is concentrated, given equal soil moisture conditions, is amply proved in literature. No lateral movement of moisture or nutrients occurs in non-porous pots and the upward movement of it is counteracted by top watering. Unequal distribution of nutrients in clay pots was demonstrated by sampling soil from 4 concentric cores. It was shown that the supply of nutrients was highest in the centre core and progressively diminished in the outer cores, concentrating again on and in the pot walls, the two inner cores acting as a reservoir for the supply. It is mentioned that a new pot will often absorb nutrients to such an extent that the plant suffers, although the moisture relations between an old and new pot are the same. From the evidence presented it is reasoned that the presence of nutrients is the most important factor in root development and that the distribution of nutrients is related to soil moisture movements.

335. HUNT, E. 664.85 : 581.175.11

Some studies in chemical preservation of fruit specimens.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 196-9.

Methods of preserving specimen fruits in their natural colours by means of chemical solutions are discussed. The author has used and acknowledged what he considers to be the best formulae of Mackenzie* and of Vacha† for fixing and holding solutions and has added a number of his own. All are described in this paper. The fruits dealt with are plums, pears, apples and strawberries. The leaves usually had to be treated apart from the fruits if their colours were also needed. It is pointed out that each fruit has to be treated individually and that no standard solution could be kept which would fulfil the requirements of any particular variety in every case. An approximate stock solution was made up which had to be modified or replaced as the reaction of the individual fruit required. Success in the preservation of colour was found largely to depend on the removal of the fixing solution at exactly the proper time. Careful observation and technique are fully as important as the proportions of the solutions. The results, though somewhat lacking the lifelike qualities of living material, retained their form and colour. The length of time of successful preservation is not stated.

TREE FRUITS, DECIDUOUS.

General.

336. CRANE, M. B. 634.1/7-1.523

The origin of cultivated fruits and the raising of new varieties.

Apples and pears : varieties and cultivation in 1934, 1935, pp. 90-7, Roy. hort. Soc., London, 7s. 6d.

Cultivated fruits can tentatively be arranged in 5 classes according to their mode of origin. (1) Gene mutations and selection within a diploid species. These give rise to numerous varieties, e.g. *Prunus persica* gave rise to peaches and nectarines, and in raspberries one gets red and yellow fruited varieties. (2) Interspecific hybridization of diploid species unaccompanied by chromosome duplication or other cytological aberration, e.g. the red currant was formed apparently from *R. vulgare*, *R. rubrum* and *R. petraeum*. (3) Auto-polyploidy, i.e. duplication of chromosomes without hybridization being involved, e.g. the Hailsham and other tetraploid forms of raspberry. (4) Interspecific hybridization of polyploid forms. There is little doubt that the garden strawberry arose from hybridization between the octoploid species *Fragaria virginiana* and *F. chiloensis*. (5) Interspecific hybridization accompanied by the functioning of unreduced germ cells or by chromosome duplication. The domestic plums, i.e. *Prunus domestica*, apples and pears and the Duke cherries appear to have arisen thus. The author expands and illustrates

* Mackenzie, A. D. The preservation of fruit in natural colours. *Mus. J., London*, 28, 1928.

† Vacha, G. A. Formulae for preserving colours in fruits and flowers. *Mimeo. Circ. Univ. Minnesota*, St. Paul, Minn., 1926.

these methods of origin from fruit varieties now in cultivation. Noting that the complexity of the nucleus and the manner of chromosome pairing is reflected in the range and nature of the variation and in the mode of inheritance of characters, and hence that it is only natural that some correlation should appear in the results of systematic, genetical and cytological studies, he considers it probable that any advance by investigators along any one of these lines will prove important to investigators on any other line. Thus the classification by the geneticist of apples and pears into two groups, those with 34 and those with 51 chromosomes, is of practical value to the fruitgrower: it may also be of use to the systematic pomologist. Considering the use of the triploid varieties of apples and pears it may be noted that, although these are themselves of vigorous growth and include some of the most valuable varieties, they are best avoided by the plant breeder since in general the offspring from triploid \times triploid or triploid \times diploid or diploid \times triploid crosses have an irregular chromosome constitution and as a result many of the seedlings die at an early stage and the survivors are mainly weak and of no commercial value.

337. WALLACE, T.

634.11 : 664.85.11

Orchard factors affecting fruit quality.

Apples and pears: varieties and cultivation in 1934, 1935, pp. 98-120, Roy. hort. Soc., London, 7s. 6d.

This wide survey of factors affecting qualities together with the discussion following outlines the results of recent investigations. The chief points, which are discussed at some length and are illustrated from trials with apples, are as follows:—(a) *Materials*. Different varieties of fruit respond differently to different treatments and environments, e.g. most culinary apples need high nitrogen conditions to produce the most desirable fruits, whereas a red dessert variety can only attain its best under "low nitrogen" conditions. Rootstocks affect appearance and taste of varieties worked on them and susceptibility to breakdown in store. Young fruit trees yield fruits which are usually abnormally large and very susceptible to physiological troubles and rots. Such fruits show, moreover, as compared with fruits from older trees, a relatively higher nitrogen in conjunction with a relatively higher sucrose content. (b) *Environment*. A dull, wet season such as 1931 in England results in fruit of very different composition to that of fruit produced in a hot dry year such as 1933. But, whereas seasons of abnormally high sunshine are associated with fruit crops of the highest quality, it is also found that abnormally high temperatures may bring about such "physiological breakdowns" in apples as the various forms of "cork", water core and bitter pit. These troubles were very prevalent after a prolonged dry period in 1929, heat waves in 1930-1932 and in the abnormally hot dry season of 1933. The effects due to soil are closely associated with climatic conditions, cultural practice and manuring. Cultural practice is of considerable importance, the main practical differences between the two extremes of clean cultivation and permanent grass being seen in their effects on soil moisture and hence temperature variation and soil nitrogen supply. The fact that grass culture greatly lowers the nitrogen content of the fruit provides the grower with a ready method for regulating quality: grass culture may also alter conditions of potassium and iron supply. Manuring greatly affects quality, the effects of N and K deficiencies in the field and those of P deficiency in pot experiments being noted. The main differences due to variation in pruning systems are most readily seen in years of heavy cropping in chemical composition and in the incidence of storage breakdown. Fruit thinning has to be drastic to have much effect on quality. When carried out rigorously it results in a smaller crop with a larger percentage of large fruits. The thinned fruits give, moreover, a higher total breakdown—mainly of the flesh type rather than core flush—in a given time than the unthinned. Ringing greatly alters quality in fruit. The main effects are:—An increase or decrease in fruit size depending on moisture conditions and on the weight of crop as affected by ringing, etc., great increase in colour, hard, white, less juicy flesh, sweetened flavour and improvement in dessert quality but deterioration in culinary properties. Chemically the salient result is a large ~~DECREASE~~ ^{INCREASE} in nitrogen content and an increase in sugar content. Storage effects are

curious. Thus in ordinary temperature store keeping quality is not usually appreciably affected except that sometimes there is an ^{DECREASED} incidence of rots and, when bitter pit is in question, increased or decreased pitting. But in low temperature store ringed fruits keep very badly, being particularly susceptible to various breakdowns. If, moreover, "ringed" fruits while still on the tree are subjected to high temperatures or drought conditions, they are very susceptible to "cork" troubles. A few trials of root pruning indicate that effects on quality are much the same as those of ringing. As regards time of pick, generally speaking the later picked fruits are of better appearance than the early picked. Chemically they are found to have an increased sugar content. Early picked fruits tend to shrivel severely on keeping and not to develop full flavour. Storage tests are as yet inconclusive. (c) *Other factors.* Terminal fruits are longer, rather juicier and "thinner" in taste than lateral fruits. They would appear to be rather more liable to rots in store but neither more nor less susceptible to breakdown than lateral fruits. Light crops are generally composed of larger fruits than are heavy crops. These large fruits tend to show high sugar content, especially of sucrose, they are often poor keepers and tend to break down in the flesh rather than at the core region. In grading by size one also automatically grades for several other properties. Thus chemically there is a definite downward gradient from large to small in sucrose, ash content and potash, while reducing sugars show a gradient in the opposite direction. Again the large fruits are generally juicier and of better flavour than the small. Further, in store it is usually the largest fruits which are most susceptible to rots and to such troubles as bitter pit. Finally, in the larger grades breakdown is most prevalent in the flesh region in the larger apples, whereas core flush predominates in the smaller ones. The subsequent interesting discussion, in which T. N. Hoblyn, W. G. Kent and W. P. Seabrook took part, throws further light on the effects of rootstock, manuring and cultivation from the points of view of the research worker, county organizer and practical grower and nurseryman.

Rootstocks.

338. QUINN, G. 634.13-1.541.11
The state experiment orchard, Coromandel Valley, near Blackwood, South Australia. Rootstocks for pear trees.
J. Dep. Agric. S. Aust., 1935, 38 : 1373-91.

The pear rootstock trial described here was started in 1909 with the object of comparing the behaviour of pear seedlings and Angers quince raised vegetatively as rootstocks for four varieties of pear, namely, Glou Morceau, Beurré Diel, Beurré Easter, and Vicar of Winkfield. Three trees of each variety were budded on to each stock, and these were planted 20 feet apart on an area of land, which in the author's opinion possessed in general a surface loam, very shallow and poor, both in texture and richness. The subsoil was clay or marl for 2 to 3 feet, which he considered should not offer too great a resistance to penetration by pear seedling roots, but would be calculated to repel the more naturally shallow penetrating quince roots. On the other hand the plot consisted of two rows running along a slope, and the trees on quince were all placed in the lower of these, so that any advantage that might result from position on the slope would probably fall to them. For the first six years all the trees made healthy growth except those of Beurré Easter on quince and one Vicar of Winkfield on the same stock. After this year the other trees on quince began to slacken in growth somewhat and came into fruit. All the trees on pear continued to grow vigorously, but started fruiting only very shortly after those on quince. Growth measurements were made in 1934 when the trees were 25 years old. In all these the trees on quince were distinctly smaller, but the discrepancy in size was very much more marked in the varieties Beurré Easter and Vicar of Winkfield than in the other two. Records of yield and quality of the fruit were kept throughout the period. Trees of Glou Morceau on both stocks started fruiting in 1917, but those on quince led in aggregate production for 11 years. Beurré Diel on quince started cropping in 1916 and on pear sparingly in 1917. The former led in aggregate yield for 16 years. Beurré Easter on the other hand did not crop on quince until 1920, three years later than on pear, and produced so few fruits on quince throughout

the period, that it might be said to have failed altogether. Vicar of Winkfield on quince fruited in 1916 and on pear three years later, but the latter rapidly outstripped the trees on quince. It should, however, be noted that the records are based on total yields of all the trees, and that one of the trees of Vicar of Winkfield on quince died in the ninth year of cropping. One of the Beurré Easter trees on quince also died in 1925, but the discrepancy was already so great that it could not have altered the position appreciably. Thus in total yield up to 25 years no variety on quince did so well as on pear, and two may be said to have shown no advantage in the first 10 years. In addition to almost complete crop failure of Beurré Easter on quince the quality of the few fruits produced was at all times very inferior. In the other varieties there was a tendency at first for the fruits from trees on quince to be superior in quality, but after a few years the positions were reversed. Thus, after 25 years, for all four varieties, the percentage first grade fruit from trees on pear was 67.55 and on quince 52.48. At present all the trees on pear except two of Vicar of Winkfield remain healthy, whilst those on quince have ceased to develop or are showing distinct signs of declining. The author concludes that on the more quickly drying clay loams on hill slopes quince rootstocks should be avoided.

339. QUINN, G. 634.23-1.541.11
The state experiment orchard, Coromandel Valley, near Blackwood, South Australia. Rootstocks for cherry trees.
J. Dep. Agric. S. Aust., 1935, 38: 1109-24 and 1245-62.

A trial to determine the effect of four rootstocks upon five sweet cherry varieties (*Prunus Avium*) was started in 1910 at the state experiment orchard. The four stocks were Mazzard (*Prunus Avium*), and Mahaleb (*P. Mahaleb*) raised from seed, the Kentish or Morello (*P. Cerasus*), raised from suckers or accidental stools, and a combination of Kentish double-worked on Mazzard. The five scion varieties, Bigarreau Napoleon, Early Lyons, Early Purple Guigne, Florence, and St. Margaret's were each represented by three trees on each stock. The data discussed in this report represent 24 years of growth, and although the nature of the layout, the fact that a few of the trees died in the first year or two, and certain other circumstances such as the depredations of birds among the fruits preclude any very accurate quantitative analysis of performance, the evidence in several directions is sufficiently marked to be significant. The relative behaviour of the scion varieties was reasonably comparable in all cases. As might be expected there was practically no sign of incompatibility between Mazzard and the scions. Both Mahaleb and Kentish showed some lack of compatibility, but this was more marked as regards ultimate effect in the case of Mahaleb. At 24 years the trees on Mazzard were still healthy though not increasing in size appreciably. Of those on Mahaleb six out of fifteen had died, and the remainder were showing more or less evidence of progressive dying back at the terminals. At the same time it could not be claimed that this stock had had an appreciable dwarfing effect in early years, and some of the trees at the time of their deaths were among the tallest in the plot. The Kentish rootstock on the other hand did have a dwarfing effect, and at 24 years the trees appeared to have ceased increasing in size. Unlike those on Mahaleb they were still, however, in a fair state of health. The use of the intermediate Kentish stem on Mazzard seems to have had no dwarfing influence, although stem girth at this point was restricted, and the performance of these trees more nearly resembles those on Mazzard. Root excavation on a few trees showed Mahaleb and Kentish to have a small system, but in the former, where large roots died, the stock seemed incapable of replacing them. No large roots of Kentish were found to have died. Mazzard, with or without Kentish superimposed, had a larger system than the others. Like Mahaleb dead roots were again in evidence, but were in this case replaced by new ones. The figures for the first seven years of cropping, though not conclusive, appear to show little difference between trees on Mazzard and Mahaleb, but a tendency for trees on Kentish and Kentish-Mazzard to crop less. When, however, the whole 18 years' cropping are considered, Mazzard and Kentish on Mazzard are shown to have given considerably more fruit than Mahaleb or Kentish. The results of the trial tend to confirm the views of growers in this district, who in recent years have used no other stock except Mazzard for sweet cherries.

340. QUINN, G. 634.25-1.541.11
The state experiment orchard, Coromandel Valley, near Blackwood, South Australia. Rootstocks for peach trees.
J. Dep. Agric. S. Aust., 1935, 38 : 1509-39.

The influence of 6 seedling rootstocks, namely, almond (2), myrobalan, peach, apricot and peach × almond, on 4 peach varieties, Briggs Red May, Elberta, Salwey and Nicholl's Orange Cling was examined in the trial discussed here. Two trees of each variety on 4 stocks and one of each on the other two were planted out in 1910. The top soil would appear to have been shallow, impoverished, rather heavy and poor in texture. During the trial the trees received standard pruning and cultural treatments, but no manure. By 1930, that is when 20 years old, many of the trees were deteriorating, and the whole lot were grubbed. Individual results are tabulated and discussed at some length. Of the rootstocks, two, myrobalana plum and apricot, gave very poor crop results in almost every case. One interesting exception, however, was Salwey on myrobalana, one tree of which was very vigorous and cropped exceptionally heavily, though the other was stunted and bore practically no fruit. The yield figures for the remaining four stocks vary in order very greatly for each variety. Fruits in all cases were divided into two quality grades and the figures produced provide some evidence in support of the popular contention that the percentage of first grade fruit tends to be in inverse proportion to the yield. There seems to be no indication, however, that this is sufficiently marked to outweigh the advantages of heavy cropping. If any conclusion may be drawn from this limited trial, it is that none of the species or varieties of the genus *Prunus* tested are likely to supersede the peach* as a rootstock for peaches.

341. PRATT, H. ST. J. 634.11-1.541.11
Apple stocks in the Stanthorpe district.
Qd. agric. J., 1935, 44 : 71-4.

In 1932 a number of vegetatively raised East Malling rootstocks were worked with Granny Smith and Jonathan. Two years later the following observations were made :—Nos. XII and XIII appear to be very vigorous, No. XVI less so,† and No. IX too dwarfing for local conditions. Nos. I and II are semi-dwarfing, and on the whole there would seem to be a tendency for most of the stocks to exhibit rather less vigour under local conditions than their records in England suggested.

342. UPSHALL, W. H. 634.11-1.541.11
Malling stocks and French crab seedlings as stocks for five varieties of apples. I.
Sci. Agric., 1935, 15 : 535-41, bibl. 2.

Malling apple stocks XVI, I, II and IX were imported and planted in the Ontario Horticultural Experiment Station in the spring of 1927. In August of the same year they were budded in equal numbers of each variety except IX (only 100 of this variety being imported against 200 each of the others) with Rhode Island Greening, Melba, Delicious, Spy, McIntosh. In 1929 the best trees of each variety were planted in a comparative test with French Crab seedling trees of similar age, selected in the nursery for uniformity and budded to the same varieties. Spy, however, was grafted on whole roots of French Crab. The layout allowed of 16 pairs being available for each variety, the results being statistically analysed by Student's method. Trees on type IX were planted apart and not included in the analysis. The only fertilizer applied was 600 lb. of acid phosphate and 300 lb. of sulphate of potash per acre in 1934. Type I has given the smallest trees, having grown poorly in the nursery. Type XVI has given the largest trees of R. I. Greening and Melba which are the most precocious varieties, and French Crab the largest trees of Delicious, Spy and McIntosh. Trees on French Crab, which were much more uniform than trees on Type XVI and on Type I, now show more variability than those on Type XVI and only slightly less than those on Type I. It is considered from data obtained that growth differences and variability between trees within a given kind of treatment can be reduced by pruning.

* i.e. peach seedlings.—ED.

† At East Malling, No. XVI makes a slow start before reaching great vigour.—ED.

The only appreciable amount of fruit produced so far has been Greening and Melba. The descending order of yield is for Greening:—Types II, I, XVI, Crab, and for Melba:—Types II, I, Crab, XVI. Type IX planted apart, budded to the same scion varieties has given heavier yields of Greening and Melba, much better coloured fruit, earlier bearing and smaller trees than any other stock. Spy, however, has not been dwarfed at all. [This is curious in view of the effect of IX on Spy at East Malling. At 12 years old the trees still average only 2.95 metres in height and began to bear fruit quite early.—ED.]

343. ESBJERG, N. 634.11-1.541.11
 Æblesorter og Grundstammer. (**Apple varieties on different stocks.**)
Tidsskr. Planteavl., 1934, 40: 646-50.

The results of 12 varieties of apples on three different stocks are worked out for three periods of 4 years each. The relative crop figures obtained were as follows, 1922-25:—on crab 32, East Malling V 24, East Malling IV 100, 1926-29:—92, 51 and 100, and 1930-33:—129, 81 and 100, making a total for 1922-33 of 112, 69 and 100 respectively. East Malling V has in all instances been a stock of little value. East Malling IV is a good cropper when young but as the above figures show the yields of trees on crab increase in comparison with those on East Malling IV as the trees grow older. There is, of course, a great difference in the behaviour of the different varieties but they show the same tendency to yield comparatively better and better crops on crab. All the promising stocks selected at East Malling are represented in experimental plots planted since 1925. N.E. [This is a tree to tree comparison and does not appear to take into account space occupied by the trees.—ED.]

344. ESBJERG, N. 634.11-1.55
 Stammeøjdens Indflydelse paa Udbyttet af Æbletræer. (**Influence of the height of trunk on the yield of apple trees.**)
Tidsskr. Planteavl., 1934, 40: 642-4.

A comparison has been made since 1924 at Blangsted of yields from trees having trunks 0.5 m. long and of those with trunks 1 metre long. Codlin Springrove (Beauty of Kent) yielded in 7 years a total crop of 98.8 tons per ha. on 0.5 m. trunk and 80.8 tons on 1 m. trunk. The corresponding total figures for Lane's Prince Albert were 44.2 and 22.6 tons per ha. N.E. [The layout consisted of 6 plots each planted with 8 Codlin Springrove and 8 Lane's Prince Albert, i.e. a total of 96 trees in all. The rootstocks were seedlings from seed of Norman Crab. Planting distance was 5 × 4.5 m.—ED.]

Rootgrowth.

345. STOUTEMYER, V. T., AND OTHERS. 634.11-1.535
Root formation in softwood cuttings of apple.
Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32: 343-6, bibl. 4.

Root cuttings about 6 inches long from 4-year-old seedling apple trees, of which the seed parent was known, were placed in sandy soil in a cool greenhouse on May 24th (in Iowa, U.S.A.). They soon produced shoots, and, when these were 1 ft. high, softwood cuttings were taken from the tips. The cuttings were inserted in July in muslin shaded frames out of doors, the rooting medium being washed sand over a layer of decomposing manure which provided a gentle bottom heat of from 65-75° F. Rooting occurred in 3-6 weeks, but it should be remarked that large numbers of the cuttings damped off and percentage of success was low. Similar cuttings were also made in September and placed in closed frames in a greenhouse. Softwood cuttings from the tips of adventitious shoots arising in the crown of 14-year-old seedling trees were treated in a similar manner in May. Seventeen out of 25 were rooted. Somewhat similar results were obtained with cuttings of Virginia Crab taken from sucker shoots arising from scion roots left in the ground after the tree had been dug up. It is suggested that these sucker shoots and juvenile shoots possess some anatomical or biochemical characteristics in common which result in the formation of roots. Softwood cuttings not of sucker growth taken from other parts of the tree fail to root, although callus formation is abundant.

346. ALDRICH, W. W., AND OTHERS. 634.13 : 581.144.2 : 631.432
Pear root concentration in relation to soil-moisture extraction in heavy clay soil.

J. agric. Res., 1935, 50 : 975-88, bibl. 17.

The studies in connection with pear orchard irrigation were undertaken in 1931 and 1932 to discover those soil zones from which moisture was extracted most rapidly in the Rogue River Valley, Oregon, and to learn whether such zones of greatest moisture loss corresponded to zones of greatest root concentration. Soil samples were taken with the improved King tube in 1 foot increments from the underside of the mulch to bed rock. In unmulched trees the samples were taken from surface level. The samples were taken starting either from the base or 2 feet from the trunk and continuing outwards at 2 foot intervals along 4 diagonals to 16 or 18 feet. A soil mass about 30 feet square was isolated round each tree by means of trenches cut either to the water table or to the bed rock, rendered watertight at the sides by means of boards and tarred paper and filled in again. Control blocks not containing trees were isolated in a similar manner. Root counts were made by marking off the inner side of the trench wall into foot squares at the time of digging, and recording all roots below 1 mm. in diameter which were exposed by picking away the soil. Root weights and distribution were found by the removal of blocks of soil of known size and position. Roots for each block were graded and weighed. The results appeared to show a positive correlation between the amount of soil moisture extraction and the concentration of small visible roots. An accompanying concentration of rootlets and root hairs too minute to be observed by the methods employed is inferred. Surface evaporation was found to affect soil moisture only in the top 12 inches. Capillary movement of moisture through the soil was insufficient to equalize amount of moisture extracted by the roots. Root concentration was not uniform throughout the soil mass. In soil 4 feet deep overlying shale moisture was extracted in the following proportions: Top foot 34%, 1-2 ft. 28%, 2-3 ft. 22%, 3-4 ft. 16%. Of total root concentration in the upper 4 feet the top foot contained 35%, 1-2 ft. 33%, 2-3 ft. 21%, 3-4 ft. 11%. The most rapid moisture extraction occurred between 2 and 8 ft. from the trunk. Between 8-14 ft. from the trunk the extraction was 5-15% less rapid. The greatest root concentrations were between 2 and 8 ft. from the trunk.

347. MARTH, P. C. 634.11 : 581.144.2
Study of the root distribution of Stayman apple trees in Maryland.
Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 334-7.

The object was to discover the concentration of "feeding roots" and other roots in the upper foot of soil in concentric areas under the spread of limbs. Such data are useful in determining response to nitrogen applications. Three localities with different soils were chosen: (1) Loose sandy loam under a loose sod overlaid by weed mowings and untilled for 5-6 years (number of trees used 7). (2) Clay loam interspersed with sandy loam of a heavier type than (1). This orchard had received a shallow ploughing and was disc harrowed each year until late July after which a rank crop of native weeds was allowed to grow (trees 6). (3) A loose limestone, shale soil with an admixture of clay loam under a sparse alfalfa sod (trees 2). The age of the trees was 20-25 years. Samples were obtained by means of a special tool consisting of $\frac{1}{8}$ inch sheet metal exactly 1 ft. square and 6 in. deep and sharpened at the base. When driven into the soil with a wooden mallet this instrument cuts off and encloses all roots within a square foot of soil to a depth of 6 inches. The enclosed soil and roots are lifted out intact and laid on a wire screen. The instrument is replaced in the hole and a second sample taken out immediately below the first. Seventeen samples each of the first and second 6-inch layer of soil were taken from between concentric rings drawn round the tree at 3 ft. intervals from 0 to 12 ft. The roots, particular attention being paid to the fibrous ones, were separated into various sizes, counted, weighed and measured. The root distribution in the first foot of surface soil varied with the soil, thus in (1) the greatest total concentration was 6-9 ft. from the tree trunks, $\frac{2}{3}$ being in the top 6 inches. In (2) which had been cultivated, the greatest total concentration was at the same distance from the tree trunk but in the lower 6 inches. In (3) with its heavier soil root

concentration was greatest nearer the tree in the 3-6 ft. ring and in the upper layer. In orchards (1) and (3) which had not been ploughed the weight of fibrous roots was very much greater in the upper than in the lower 6 inches of soil, and of all roots together 70% more were found in the upper than in the lower layer. In (2) which had been ploughed the bulk was in the lower 6 inches, though the differences between the two layers were much less than in (1) and (3). The total growth of fibrous root per foot width of concentric area about the tree apparently reached its maximum in the lighter soils at 6 ft. from the trunk and in the heavier at 9-12 ft., beyond which sampling did not go. The maximum concentration of fibrous roots per cubic foot of soil was found within 6 ft. of the trunk.

Growth, Nutrition.

348. ALDRICH, W. W., AND WORK, R. A. 634.13 : 581.144.2
Evaporating power of the air and tap-root ratio in relation to rate of pear fruit enlargement.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 115-23, bibl. 8.

The inverse relation between evaporating power of the air and rate of fruit enlargement of pears on heavy soil, while soil moisture was well above the wilting percentage, suggests that during periods of high transpiration the leaves lose water at a greater rate than the water is supplied by the roots from the available moisture in the soil. When for such trees the ratio of root area to leaf area was increased by the removal of leaves, the water supply of the remaining leaves and fruits was increased. From these results it would seem that for these pear trees, when the available soil moisture had been reduced to 35 or 40 per cent. of the available capacity, the moisture supply to the leaves during periods of relatively high transpiration was limited by the amount of root area. [Authors' summary.]

349. LITTLELAND, O., AND NEWSOME, L. 634.23 : 581.145.2
A growth study of the cherry fruit.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 291-9, bibl. 6.

In 1934 30 fruits of each of six varieties of sweet cherries were tagged and measured at two-day intervals from a few days after full blossom up to maturity. It was found that, when this number of fruits is used to supply averages, non-synchronism is not a serious source of error. Diameter growth curves were singularly smooth, and all varieties showed periodicity. Initial rapid growth is followed by a depressed period and this in turn by rapid growth to full size. The varieties entered the depressed period in sequence of their blooming, and emerged in order of their ripening. Measurements of endocarp cross-diameter growths were made on sample fruits removed from limbs adjacent to those bearing tagged fruits. Cessation of growth of the endocarp occurs from 12 to 17 days after full bloom and coincides in general with the inception of the depressed period. The slowing down of growth of the fruit during this period is shown to be largely a reflection of the cessation of diameter growth of the endocarp. The embryo appeared approximately 5 days after the depressed period had started, and its length growth was completed 14 days later, that is 30 to 36 days after full bloom. This happened irrespective of the variety and its time of ripening. There appears to be no correlation between embryo growth, the duration of the depressed period, or the time of resumption of rapid flesh growth. In the case of drupe fruits it may be generally stated that the endocarp and embryo complete their dimensional growth before they attain their maximum rate in increase in total solids. A similar independence of development is observed in the flesh, but is less marked, because maturation coincides more or less with increase in size. The occurrence of embryo abortion is not characteristic in early-ripening cherries in California, but there is a tendency to shrivel after ripening and to lack the plumpness found in the later kinds. This is probably associated with a low fat content in the seed, which in turn may be connected with the shorter time between cessation of

embryo dimensional growth and maturity of the fruit noted in earlier ripening varieties. In other words the fruit may ripen before the seed is fully mature.

350. BARNARD, C.

634.11 : 581.145

Studies of growth and fruit bud formation No. 5. Observations during two seasons on South Australian apples.

J. Dep. Agric. S. Aust., 1935, **38** : 1129-39.

The investigation described here has centred mainly around five trees of each of four varieties, Dunn's Seedling, Jonathan, and Cleopatra planted in 1908, and Granny Smith planted in 1910. The stock in each case was Northern Spy, but some of the Granny Smith trees had been double worked with an intermediate of another variety. The principal features studied during two successive seasons were shoot growth, and fruit bud differentiation and development. In the first season, 1932-33, all varieties gave a very light crop, and in the second a heavy crop. The fruit buds studied were terminal buds of young spurs on two-year-old wood and terminal buds on spurs two years of age or older. Terminal buds of laterals were not examined. Samples consisted of 60 buds taken first at weekly and later at fortnightly intervals from the end of November to the end of March, and thereafter at about three-weekly intervals to the beginning of September. The procedure in the second season was similar though not identical. The time of differentiation was based on the first morphological indication as seen in the elevation and broadening of the crown of the bud axis. Differentiation occurred over a period of two to three weeks, and in the first season, 1932-33, in three varieties the majority of the buds differentiated in the third week of December. The fourth variety, Granny Smith, was about 11 days later. In the following season while the trees were carrying heavy crops, Dunn's produced insufficient fruit buds to make a count, and in the other varieties differentiation tended to occur a few days earlier. Detailed shoot growth measurements were made during the same period, and showed that the carrying of heavy crops, as in the 1933-34 season, tended to cause the earlier cessation of shoot growth, the production of shorter shoots with shorter internodes, less leaves, but later defoliation. As shown above this less vigorous shoot growth is accompanied by slightly earlier differentiation of the fruit buds. On the other hand once differentiation has occurred it would appear that the conditions which favour vegetative growth also accelerate the development of the fruit buds.

351. GARDNER, V. R.

634.23 : 575.252

A study of some unproductive sports of the Montmorency cherry.

J. agric. Res., 1935, **50** : 457-78, bibl. 12.

Observations made during recent years in a large number of cherry orchards in Michigan, coupled with a study of individual tree records, has convinced the author that the appearance of unproductive bud sports is of much more common occurrence in the sour cherry variety, Montmorency, than was generally suspected. The present investigation was therefore undertaken with a view to determining the real status of the problem. The criterion used in all cases was fruitfulness. This was judged in the case of branch sports by comparison with the rest of the tree, and in the case of whole-tree variants by comparison with normal trees. A range of selections was made between types showing a substantial reduction compared with the normal and types which were almost completely barren. These are classified as follows: (1) Types failing to form visible flower buds where these are normally differentiated. (2) Types in which leaf buds occur in place of flower buds. (3) Types showing marked susceptibility to low temperature injury when dormant. (4) Types susceptible to injury from less severe temperatures while in delayed dormant or early post-dormant condition. (5) Types very susceptible to frost damage in flower buds or opening flowers. (6) Types characterized by poor setting. Variants classified according to any one of these factors show a marked tendency to further crop reduction on account of one or another of the other factors. From a commercial standpoint the almost barren variants are less important than the ones that are merely rather unproductive, because they can be easily seen and replaced. The types susceptible to low temperature injury may, for example, bear normally in some years.

352. HEINICKE, A. J. 581.13 : 634.11
Photosynthesis in apple leaves during late fall and its significance in annual bearing.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 77-9.

The application of 3 lb. ammonium sulphate to apple trees late enough in summer (August 4th, New York) to avoid forming a second shoot growth but soon enough to increase and maintain at high level the photosynthetic activity of the leaves until they fall is shown to increase the extra reserves of the stem tissues above the ordinary amount. This results in the development of a large leaf surface the following spring, a process which has an important bearing on bringing about regular bearing. It is particularly important that efficient photosynthesis should take place in the foliage during the off- or light-crop year, since, if the trees have formed a large percentage of fruit buds during this year, a great part of the reserve food will be required by the opening of the flowers and insufficient will be left for the accumulation of carbohydrates associated with the initiation of next year's flower buds.

353. LOOMIS, W. E. 581.175 : 631.84
Translocation of nitrogen in woody plants.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 61-4, bibl. 6.

Though the importance of nitrogen fertilization of fruit trees is universally recognized, the manner of its accumulation and movement through the plant is still a matter of dispute. Data and a hypothesis are here presented with the object of throwing further light on the matter. The experimental material was obtained from 5 and 15-year-old apple trees, 3-year-old poplars and 8-15-year-old box elder seedlings. Protein nitrogen was found in large quantity stored in the bark and wood of trees, from whence it was digested and used in early spring growth. This may account for the success of autumn manuring with nitrogen and the cumulative effect of nitrogen fertilization with ammonia. Nitrogenous salts appear to be synthesized to organic compounds in the normal roots of apple and other trees and as a result they can be readily translocated only in the phloem. If this be true then ringing must stop the upward movement of nitrogen as well as the downward movement of carbohydrates. The conditions under which nitrogen has been found to move upward past a phloem ring are, (a) when the storage tissues have been injured by continual ringing treatment, and (b) when the carbohydrate ratio of the roots was reduced to a low value. The following hypothesis is advanced by the author. *Inorganic* nitrogen can pass through normal cell membranes into the transpiration stream, but *organic* nitrogen cannot readily do so, and therefore its upward and downward movement is normally confined to the plasmodesmal connections existing between living cells and especially developed in the phloem.

354. LEWIS, M. R., AND OTHERS. 634.13-1.432
Influence of different quantities of moisture in a heavy soil on rate of growth of pears.

Plant Physiol., 1935, 10 : 309-23, bibl. 9.

This paper presents an analysis of the rate of growth of fruit throughout the season as compared with the corresponding soil moisture conditions and forms a portion of studies initiated in 1930 at Medford, Oregon, to determine the best methods of irrigation of heavy soils for the production of large yields of high quality pears. The trees, mature Bartlett's and Anjou, all on French roots, were located in 3 orchards and both plots and trees were selected as far as was possible for uniformity and received identical cultural treatment. The climate is semi-arid with a long growing season and almost continuous sunshine during the summer. Irrigation water was available on demand except after July in 1931. It is shown that there is a slowing down of growth of fruit as the quantity of water in the root zone decreases, even though wilting point may never be reached. The reasons suggested for this are as follows: Soil moisture becomes actually less available to the roots as the thickness of the moisture film decreases and this process must start as soon as the balance between gravitational and capillary force descends on the side of the former, becoming more marked as wilting point is approached. When the moisture in the soil is at field capacity as after an irrigation, each root

hair is in contact with a film of water, but as water recedes the growing points find it increasingly difficult to follow the retreating water films and many cease to function, while those that remain active become progressively less able to supply sufficient water to keep the fruits in full growth. Since it is impossible for the roots to come in contact with every soil particle and its enveloping moisture film, the water from those particles not in contact with active roots must move towards those roots before actual wilting point is reached. The distance to be travelled will depend on the quantity of roots in the soil and the rate of movement on the texture of the soil, and thus the amount of water supplied to the tree may be governed not by the rate at which the roots can take up moisture, but by the rate at which water can move through the soil to the roots. Thus the soil actually surrounding the roots may be at wilting point, but a little further away may have a comparatively high moisture content, and samples taken by ordinary methods to determine moisture content would produce an average of the two. This, in tight soils where water movement is slow and root development sparse, would account for the effect on fruit growth of comparatively small changes of the average moisture content in the root zone.

355. HINTON, J. C. 664.85.11 : 631.542.24 + 631.542.27
Studies on maturity of fruit. IV. The catalase and oxidase activity of apples in storage as affected by conditions obtaining during growth.

Annu. Rep. Long Ashton Res. Sta. for 1934, 1935, pp. 29-52, bibl. 16.

Three samples of apples were picked on different dates close to the normal picking date, (1) from trees ringed in the same spring, (var. Newton Wonder), (2) from trees growing under a grass cover crop (var. Allington Pippin), (3) from trees thinned—though at a late date—(var. Allington Pippin) and were subsequently compared with apples grown under cultivation, not ringed and not thinned respectively. The apparatus used for the catalase determination is described and illustrated. It was hoped to get reliable quantitative results by the use of a modification of Bunzell's method, but these were not forthcoming. The following notes are taken from the author's summary of results obtained, which are also set out in graphs. Catalase activity of stored apples increased during storage, but in three cases, in the later stages, it subsequently decreased. The exact nature of the change in catalase activity differs in apples picked at different stages of maturity and in apples grown under different treatments. In the case of Newton Wonder differences in the rate of change during storage suggests that fruits from ringed trees mature more slowly than those from unringed. Oxidase activity of apples decreases markedly but slowly during ripening on the tree and during storage. Differences in the change in oxidase activity were found in fruits picked at different stages of maturity and grown under different conditions. Further work is necessary to develop a more suitable method of determining differences due to different cultural treatments.

356. HINTON, J. C. 664.85.11 : 631.542.24 + 631.542.27
Studies on maturity of fruit. V. The effect of conditions during growth on the progress of softening and on the loss of total weight in apples during storage.

Annu. Rep. Long Ashton Res. Sta. for 1934, 1935, pp. 53-83, bibl. 18.

The samples used for the softening and loss of weight investigations were the same as those described above for the author's catalase and oxidase tests. [See previous abstract.] Softening was tested at definite intervals by a pressure tester based on Murneek's design, the plunger being $\frac{1}{2}$ inch in diameter, rounded at the tip, and penetrating $\frac{3}{8}$ inch into the flesh of the apple. Certain modifications which greatly facilitated rapid and accurate application of the test are described in detail with illustrations. By these modifications the pointer becomes self-locking. Results of growth conditions on softening and on loss of weight are tabulated and graphed. The author summarizes them and comes to the following conclusions. As regards softening in store the work of previous investigations is in general confirmed. The present results suggest that apples growing on trees (1) under grass, (2) ringed, or (3) thinned were all ripening less rapidly during the later period on the tree than were the respective controls grown without grass and without the specified treatments. The rate of loss of weight was different for each sample of

apples taken. The rate of loss diminished during storage until the final stage when in most samples it increased again. The variance in respect of loss of weight increased, the later the samples were picked. The rate of loss, the extent to which this diminished in store and the variance of the samples were all found to be related to the stage at which the samples were picked. The nature of this relationship suggests again that the fruit from the grassed, ringed and thinned trees were ripening more slowly during the later stages of growth than their controls. It is suggested that the variation between individual fruits is due to a different metabolic state of these individuals. It is further suggested that a main factor governing loss of total weight is biological in nature and that loss of weight is a function of the metabolism.

357. HINTON, J. C. 664.85.11 : 631.542.24 + 631.542.27

Studies on maturity of fruit. VI. The effect of conditions during growth on some chemical constituents of apples in storage.

Annu. Rep. Long Ashton Res. Sta. for 1934, 1935, pp. 84-108, bibl. 17.

Samples were taken as set out in abstract 355 above. The following points were noted. *Total nitrogen* decreased during storage, the rate of decrease being greatest during the earlier part of the storage and being influenced by the stage of maturity of fruit at time of picking. In the Allingtons the rate of decrease was in general greater in fruits picked at a later stage, but in the Newtons was less. The nature of the relation of this rate to the stage of maturity at picking agrees with the suggestion that the grassed, thinned and ringed fruits were not ripening so rapidly as their controls. *Acid hydrolysable material* decreased markedly during storage, but in many cases increased towards the end of storage life. Previous work on *total sugars* is confirmed. In the days immediately after picking there is a rise due to the hydrolysis of starch : this is followed by a fall due to respiratory loss. The rate of loss of *sucrose* as calculated for the steepest part of each curve decreased between succeeding picks in the Allington series, but tended to increase in the Newton series. The amount of increase in *reducing sugars* in storage and the length of time during which increase took place was less with succeeding pickings in each case. This confirms previous work. It was, however, found in these investigations, contrary to results of previous workers, that the rate of increase in store decreased in all cases with succeeding pickings. The *ratio reducing sugars : sucrose* increased during storage in all cases. It is interesting to note that the increase in value of this ratio was less in the later picked Allingtons and that the nature of the results indicates that the fruits from the grassed and the thinned trees may be considered to be ripening on the trees more rapidly than the controls, a conclusion contrary to that afforded by other data mentioned above in abstracts 355 and 356.

358. CHURCH, C. G., AND SORBER, D. G. 634.16 : 581.192

The chemical composition of the loquat. (*Eriobotrya japonica*.)

Fruit Prod. J., 1935, 14 : 335-40, bibl. 13.

The chemical composition of three well-known varieties of loquat grown in Southern California, namely, Champagne, Advance and Thales, has been investigated for two seasons, the fruit being obtained from commercial orchards in Orange county, and the results are presented in tabular form together with a discussion on them. Analyses by other investigators of this fruit have been tabulated, along with similar data on the apple, and compared with the results obtained by the authors. [From authors' summary.]

Pollination.

359. PESCOTT, E. E. 634.13 : 581.162.3

Pollination of pears. Results of 1934 tests.

J. Dep. Agric., Vict., 1935, 33 : 272-6, 280.

Fruit World, Melbourne, 1935, 36 : 354-7.

The following results were obtained in experiments carried out by the Department of Agriculture in certain private orchards in Victoria. Josephine de Malines hand pollinated by Packham's

Triumph gave an average fruit set of 19.8%, with Winter Nelis 19.4%, with Winter Cole 13.4% and with Black Achan 3.1%. Three applications of pollen gave markedly better results than two. Beurré d'Anjou hand pollinated gave the following sets: with Keiffers Hybrid 7.1%, with Howell 6.4%, with Monchallard 5.4%, with Harrington 4.2%. Doyenné du Comice is not a certain cropper in Australia. [This is also the case in England and attempts are being made at East Malling to find suitable pollinators for it.—Ed.] Fruit sets with the following pollen parents were with Josephine 5%, with Williams' Bon Chrétien 4.08% with Winter Nelis 3.5%, with Winter Cole 3.1%. It is thought, however, that other factors besides lack of a suitable pollinator are involved in the failure of Comice to bear and this aspect of the problem is being studied. Seed production in view of the fruit set was disappointing.

360. BOWMAN, F. T.

634.23 : 581.162.3

Cross pollination of cherries.

Fruit World, Melbourne, 1935, 36 : 313, 324.

Pollination tests in New South Wales have shown that three of the principal varieties planted up since the war, namely Early Lyons, Florence and St. Margaret, are partially or wholly self-sterile, and furthermore to a certain extent cross-incompatible with each other. Early Lyons is best pollinated by Early Rivers, Burgdorff, Early Purple Gean, and Eagle. St. Margaret is satisfactorily pollinated by the common (white or late mottled) Bigarreau, or, in seasons when blossoming overlaps, by Eagle or Bleeding Heart. Further tests are necessary to establish the best pollinator for Florence which is self-sterile, but Napoleon, which is to some extent self-fertile and noted for good cropping, is indicated as satisfactory. Strains of the chief varieties have been found in several cases, and since they may react differently to the parents it will be necessary to identify them carefully. General recommendations include careful selection of bud wood, and where bees are absent the establishment of one hive per acre. Where blocks of one variety already exist one leader on each tree should be grafted with a pollinator variety, or, if the graft fails, budded the following year; or alternatively, complete top working with perhaps two pollinator varieties of one tree in every nine is suggested.

361. DEGMAN, E. S., AND AUCHTER, E. C.

634.11 : 575.18

Metaxenia studies with apples.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 213-9, bibl. 37.

Results obtained from different sources providing nearly 500 apples showed that none of the different pollens used gave rise to any appreciable metaxenial effects.

Cultural Practice, Manuring.

362. FOWLER, R.

631.512 : 634.1/2

Tests to determine the effect of digging or deep ploughing close to fruit trees while in full bloom.

J. Dep. Agric. S. Aust., 1935, 38 : 784-5.

Experimental material consisted of 36 trees of Elberta peach and 36 trees of three varieties of apples. The whole area was shallow-ploughed in early September, the first three furrows from the trunks of the trees to 3 inches only, and the remaining interspaces to 5 inches. Later in the same month, when the peaches were in full bloom, the land around each alternate tree was roughly and deeply forked to about 8 inches. Many small fibrous roots were broken, and in some cases clay subsoil was brought to the surface. Similar treatment was meted out to alternate apple trees between the second and third week of October, just as each variety came into full bloom. The ensuing growing period was unusually dry, but no apparent growth differences between treated and untreated trees were recorded. Likewise no significant difference was found in cropping in either case. The experiment is being repeated.

363. WILSON, J. 631.542 : 634.1/2
The winter pruning of apples, pears and plums.
Apples and pears. Varieties and cultivation in 1934, pp. 7-13, Roy.
 hort. Soc., London, 1935, 7s. 6d.
 and,
 LEES, A. H. 631.542 : 634.1/2
Summer pruning of hard fruits.
Ibidem, pp. 14-20.

These two papers, together with the discussion following, form a useful practical guide. The factors governing winter pruning, namely soil, stock, rainfall, variety, form of apple tree, whether espalier, cordon, bush or standard, are considered in the first paper, and the actual operations involved in pruning leaders and laterals are described in detail, with reasons for each step. It is noted that the pruning of pears follows the same lines, while plums require little pruning once the tree is formed, beyond the occasional shortening of a leader and the removal of crossing or diseased or damaged branches. In the second article the objects of summer pruning are stated to be the promotion of spur formation especially in young trees, strengthening of desired leaders by removal of competitive shoots, and increased size and colour of fruit. Considerable attention is given to the so-called Lorette system and the adaptation thereof by Lees to conditions obtaining in the West of England and named by him the "Modified Lorette" system. Briefly the modified system is as follows:—Only one summer pruning is performed instead of three as in the Lorette system. This is normally carried out about June 30th for pears and about July 20th for apples. The second modification is that cutting is done to two good eyes instead of to the basal cluster (by a "good" eye is meant one distinctly visible at time of pruning). The two buds thus left give three possible types of reaction: neither bud grows out but both are plumped up, or one grows out and the other is plumped up, or both grow out. In the first case nothing need be done next winter and one or both will go over into flower buds. If, as in the second case, No. 1 bud grows out and No. 2 does not, then in winter No. 1 shoot is pruned to 2 buds. In the following summer the original No. 2 changes into a dard or flower bud. No. 1 bud of the winter pruning produces fresh growth and new No. 2 bud of the winter pruning produces an incipient dard. This time the new No. 1 in the double system is not pruned to 2 eyes but to 1 eye. In the course of years the structures so formed become more complicated. They may contain several dards and shoots but no flowers, if conditions are unfavourable. In such cases some of the shoots may be cut back behind visible eyes, one or two being left, and cut to one bud. In the third case where both summer pruned buds grow out, nothing is done till the winter, when one bud is left on No. 1 and two on No. 2 shoot. The subsequent history is as in the second case. By this system, as in the Lorette, two buds are typically present on the bourse. It is important that these spurs should not elongate too much, and therefore, grown out bourse buds are cut hard to the heel. The rule for pruning bourse shoots on a simple spur is to prune them hard to the base. When the spur later becomes a spur system and is covered with incipient fruit buds, dards and shoots, a rather less drastic pruning is advisable. One or more shoots are then cut to one eye so as to act as sap drawers, the rule being that the stronger the buds behind, the more sap drawers should be left. Developing dards must be stimulated slightly but not forced out. The author considers that the advantages of the "Modified Lorette" over the Lorette system are that only one operation is necessary each summer instead of three, thus making it a commercial proposition, and secondly that it does not depend on the production of stipulatory eyes, but works on those already present, thus adding to the chances of success.

364. BLACK, M. W., AND MICKLEM, T. 634.1/2-1.541.44
Top-working fruit trees.
Fmg. S. Afr., 1935, 10 : 295-6.

The common system of top working unprofitable trees by cutting off all growth down to the bases of the main branches followed by grafting has proved unsatisfactory in South Africa. Trees so treated are generally dwarfed, do not bear well for some years, and are subject to die-back.

Three modifications of an improved method are described here.* In the "Porcupine" system the tree is not cut right back, but is merely trimmed to a point at which the upper branches have a diameter of about 1 inch. Thinner laterals are then cut back and "whip" grafted, while thicker laterals and branches are "cleft" or "side" grafted. The "refurnishing" or "improved porcupine" is another method, which would appear to give the best results under South African conditions. The trees are trimmed as before, but in this case all spurs and laterals are removed. Grafting is done late in the spring using scions about 5 inches long, carrying 4-5 buds. It is best to cut fresh wood as required, although storing may be necessary to ensure dormancy. The shoot is cut in the form of a wedge, one face being cut longer than the other, and is inserted into an inverted L-shaped cut in the wood of tree. Contact with the cambium is maintained by driving a small tack through the enveloping bark and scion. This process is repeated all round the main arms so that scions are 6-7 inches apart. The ends of branches are "bark" or "cleft" grafted. All unions are covered with grafting wax. A further modification which gave equally good results, but made the operation much quicker, was tried at Stellenbosch. Instead of an inverted L-incision a single slanting vertical cut was made in the bark of the tree. The scion is then forced under the bark at an angle to the main axis, when further support by nailing becomes unnecessary. Either of the last two systems are recommended for use on pear and apple trees. In the case of pears a 90 % "take" was obtained, and it was noted that thicker scions "took" better than thin. A good crop may be expected in the second season. In all cases suckers from the original tree should be rubbed off when about 2 inches long.

365. ROBERTS, R. H.

634.11-1.541.3-1.541.11

Ring grafting and stock effect.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 328-9, bibl. 3.

One-year-old nursery trees of different apple varieties were cut back to a height of about 8 inches and subsequently rings of bark about $\frac{7}{8}$ inch wide were removed at about 5 inches above ground, and replaced by rings of various stock and other varieties including bark rings of the tree itself. Checks were provided by untreated trees. Some varieties gave poor stands but the growth development of others since grafting has been measured for one season, and these figures expressed as ratios of the growth during the previous year indicate an unequal effect from the rings. In particular some of the graft combinations resulted in as much or more growth than was made by the untreated trees, but grafting varieties with their own bark was among the treatments resulting in a reduction. The accumulation of starch above the rings appears to be closely related to the amount of shoot growth made by the new shoots.

366. ALLEN, F. W.

634.11-1.8 +1.542.24

Influence of sugar, nitrogen fertilizers, and of ringing Gravenstein apple trees upon color and maturity of fruit.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 52-5.

Any treatment that will increase the colour of Gravenstein apples would be of great commercial value. Increase of colour has previously occasionally been obtained by the addition of sugar to the soil with the object of lowering the nitrate content.† Trees of varying degrees of vigour, on sandy loam and gravel, and on deep clay loam, were each treated on May 25th, 1933, with a solution of 50 lb. cane sugar to 125 gallons water injected into the soil under the branches to a depth of 3-4 ft. Two other trees received 50 lb. calcium nitrate dissolved and treated in a similar manner. Branches of other trees were girdled to reduce the normal calcium nitrate ratio. On the sandy loam the nitrates, already lower than on the clay loam, were markedly reduced by the sugar treatment. On the clay loam the results were inconsistent. Calcium nitrate treatment raised the nitrate content of the soil materially, but the trees showed no response. At harvest, July 12th to 26th, when usually of a

* See also *H.A.*, 1934, 4 : 2 : 165 and 1935, 5 : 1 : 13.

† Fletcher, L. A. Preliminary study of factors affecting the red color on apples. *Ibid.*, 1929, 26 : 191-6.

maturity considered satisfactory for shipment, no differences in colour or firmness could be discovered between treated and untreated trees. In 1934 the trees on the clay loam were again treated, but cane sugar and ammonium nitrate was substituted. Three applications of the cane sugar were made March 28th, May 2nd and 24th, this time by scattering the sugar on the ground and heavily flooding the trees. Main limbs of treated and untreated trees were girdled on May 2nd. On June 13th, when half the crop was picked, a 10% increase in soluble solids in the fruit of sugar treated trees over that of the untreated and nitrated trees was found. Ten days later at the final picking this difference had disappeared. There was no difference in colour or firmness. Fruit from girdled limbs was consistently higher in soluble solids and in reducing and total sugars than that from non-girdled limbs. It is noted that, if Gravenstein were allowed to attain its full colour before picking, the differences might be greater, but it is now harvested so early that the time in which it can respond to any colour treatment is very short.

367. HARLEY, C. B., AND OTHERS. 634.11-1.542.27
Fruit thinning and biennial bearing on individual main leaders of Yellow Newtown apples.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 43-6, bibl. 3.

Further experiments in severe fruit thinning performed within 40 days after full bloom at Wenatchee, Washington, on main leaders of Yellow Newtown are stated to have confirmed the results of a previous experiment* and to have brought into bearing the following season trees which would normally be in their off year. Heavy thinning is defined as thinning to a ratio of 70 leaves or 1,900-2,000 sq. cm. of leaf surface per apple. Commercial thinning allows 25 leaves per apple and on-year trees thus treated failed to form a single blossom bud. Thinning later than 40 days after bloom and/or leaving a smaller number of leaves per apple gave greatly inferior results, while under Middle Atlantic conditions the thinning had to be carried out within 30 days of bloom to ensure success. It is claimed that the biennial bearing habit thus broken can be converted into regular annual bearing, if care is taken to provide the proper high leaf ratio from year to year. Trees treated successfully by early heavy thinning for one year and untreated subsequently reverted to biennial bearing but with the crop year reversed. It is also shown that the leaders on the same tree act independently of one another and that the treatment will only influence the leader to which it is applied.

368. BROWN, G. G. 634.11-1.542.27
Bulk fruit thinning and wide spacing of Newtown apples.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 47-9.

Three large 25-year-old Newtown apple trees were each thinned by one of the following methods on June 10th, following a light annual pruning in early spring. The number of apples per fruiting spur for the trees 1, 2 and 3 before the June drop was 3.6, 3.4 and 3.1 respectively. No crop had been produced the previous year (1932). *Tree No. 1* Bulk thinning. The tree was divided into 8 equal areas by perpendicular planes extending from the centre to the circumference. All fruit was in alternate areas entirely removed or thinned to a spacing of 5 to 6 inches. The total thinnings for (a) numbered 7,150, for (b) 3,993, or 11,143 for the entire tree. The leaf ratio established was 1-12.4 within bearing sections or 1-24 for the whole tree. *Tree No. 2.* Wide spacing. Spurs were uniformly spaced 10-12 inches apart and thinned to 1 apple each. The total number of thinnings was 11,540. Leaf ratio 1-25. *Tree No. 3.* Narrow spacing. The thinning was to 5-6 inches between fruits throughout the tree. Total numbers of thinnings 7,561. Leaf ratio 1-11.4. Growing season was normal till a high August temperature caused a definite slowing down. The yields were as follows: *Tree No. 1* bulk spacing, 3,402 apples; *No. 2*, wide spacing, 3,022 apples; *No. 3*, narrow spacing, 5,462 apples. On account of its greater yield the crop from tree No. 3 made the most money, \$27.11 against \$20.57 for tree No. 1. In actual value of fruit per packed box, however, it was

* Harley, C. B. and others. Fruit thinning and biennial bearing in Yellow Newtown Apples. *Ibid.*, 1933, 30 : 330-1.

below both trees No. 1 and 2. The effect of this thinning on the following season's blooming (the off-year) was not noticeable except for the portions of tree No. 1 from which the fruit had been entirely removed. Here the percentage of bloom was 22.6 against 2.2 for the thinned portion.

[In these experiments the number of leaves left per apple was never higher than the commercial one of 1-25. To influence biennial bearing the ratio according to Harley, see previous Abstract should be 1-70.—ED.]

SMALL FRUITS, VINES, NUTS.

369. GRUBB, N. H.

634.711-1.523

Raspberry breeding at East Malling, 1922-34.

J. Pomol., 1935, 13 : 108-34, bibl. 6.

An outline is given of the progress made in raspberry breeding during a period of 13 years. In the form of an introduction the objects of the work, the characters of a good commercial raspberry, the varieties at present in cultivation from which a breeder might obtain these characters, and a score card used for judging the commercial value of the fruit are in turn described. Some 35 families have been studied. Some of these were produced by selfing named varieties, others by crossing some of the same varieties, and yet others by crossing the seedlings raised by selfing. From the results to date it would appear that the better varieties, when selfed, do not necessarily produce the largest proportion of promising seedlings. The foremost commercial varieties in fact proved rather disappointing, and in only very few cases did any of their seedlings exhibit any improvement on the parents. Some of the poorer varieties, when selfed, gave a proportion of seedlings definitely superior to themselves, although again few were sufficiently superior to merit an extended trial against the better commercial types at present in existence. Furthermore, those varieties, which when selfed gave the largest proportions of promising seedlings, did not always give equally promising results on crossing. The most hopeful results were obtained by the crossing of promising seedlings, especially those produced by selfing. Such seedlings are less heterozygous than their parents, and the families raised from crosses between them show less variability than do crosses between their respective parents. This narrower range might seem to be disadvantageous, but it was found that the greater variability exhibited by families resulting from variety crosses was associated with appearance of one or more undesirable features in almost every member. The author considers, too, that it is important that selfed seedlings chosen for crossing should not have the faults of their parents in a degree equal to that of the parents. The paper concludes with an account of data collected on the inheritance of colour, sex, and hairiness, with special reference to work on this subject by Crane and Lawrence.

370. SLATE, G. L.

634.711-1.523

The best parents in red raspberry breeding.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 407-10.

From this summary of raspberry breeding work carried out over many years and with many varieties it would appear that Lloyd George has proved to be one of the most valuable parents. The most promising seedlings in 1934 have been derived from crosses between it and Newman and Newburgh, and to a smaller extent from crosses between it and Sta. 1950 (Empire × Herbert). Newman has proved nearly as good as Lloyd George as a parent, outstanding crosses being those with Herbert and Cuthbert. Loudon crossed with Marlboro has resulted among other named seedlings in June, and is also a parent of Latham, King being the other. June and Marlboro have given fair results especially in introducing earliness and bright fruit colour. Herbert is soft-fruited, and has only succeeded in crosses with firm-fruited Newman. Cuthbert transmits high fruit quality, but has not given many good seedlings. Latham has not been used sufficiently to test its breeding value, but so far has shown little promise. It deserves attention, however,

on account of its resistance to mosaic and its adaptability to conditions of soil and climate. Varieties which have proved inferior as parents in combinations are Erskine Park, Buckeye, Count, Donboro, Empire, Owasco, Syracuse, Gold Drop, Ohta, Ranere, Superlative, Newman No. 20, and Marldon. None of the varieties good or bad when selfed produced any seedlings of note whatever.

371. SCHWARTZE, C. D. 634.711-1.523
Further observations upon Lloyd George red raspberry as a parent in breeding.
Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 411-5, bibl. 2.

The data presented here are additional to those previously published by the same author,* and concern fruit characteristics of hybrids between Lloyd George and other raspberries. Desirable fruit shape, taken to be conic or oblong-conic, was shown by a large percentage of seedlings from Cuthbert \times Lloyd George, and Latham \times Lloyd George. The results of other crosses, however, do not support the former contention* that Lloyd George represents the homozygous dominant condition for fruit shape. As regards size the largest percentages of large-fruited hybrids came from the same two crosses as above. Flavour was rated as insipid, sweet, sub-acid, or acid, the two middle types being the most desirable. A high proportion of well flavoured seedlings were produced from several crosses in which Lloyd George or Cuthbert were one of the parents. None of the other varieties, King, Marlboro, Antwerp or Latham when crossed with each other produced hybrids with outstanding flavour. The characters noted above, together with desirable plant type and early to mid-season maturity, constitute the bases for selection, and an examination of the parentage of the seedlings selected in this trial emphasizes the outstanding value of Lloyd George as a parent, especially when crossed with high quality varieties like the Cuthbert.

372. HOWELL HARRIS, G., AND WOODS, J. J. 634.711-1.8
Raspberry nutrition. I. Seasonal variation of plant nutrients in raspberry plantings under different cultural treatments.
Sci. Agric., 1935, 15 : 525-34, bibl. 9.

Raspberries at Agassiz, British Columbia, were planted in the spring and were then divided into plots and subjected to different cultural treatments, namely, cover cropping with rye, clover or vetch, complete fertilizer, farmyard manure, nitrogen and nothing. In the various combinations this gave 28 treatments and each of these was replicated over 5 blocks. The cover crops were subsequently turned under. On six occasions during one year soil samples were taken to obtain an estimate of the available plant nutrients at different seasons. A low calcium content in the spring was correlated with poor physical conditions owing to deflocculation, and an application of lime in the autumn is recommended. Rapid leaching of all nutrients during the winter suggests that cover crops grown during this period should be beneficial except on poor soils. The application of sodium nitrate in the spring was not found to increase the available nitrate in the soil, which in any case reaches a high concentration in May, but they did indirectly increase the available potash and, to some extent, the magnesium. In June and July, however, the soil nitrate concentration falls very rapidly, and for crops growing at this season it is suggested that the application of available nitrogen should then be of benefit.

373. MINISTRY OF AGRICULTURE, LONDON. 634.714
Loganberry cultivation.
Advis. Leaflet. Minist. Agric. London, 129, 1932, reprinted 1935, pp. 4.

This leaflet supplies a brief guide to general practices of propagation, soil and situation, preparation of the land, plantation planning, planting, management, and gathering and marketing. Notes are given on the control of the loganberry beetle *Byturus tomentosus* and on cane spot disease *Elsinoe veneta*.

* Schwartze, C. D. The genetic constitution of certain red raspberry varieties in relation to their breeding behaviour. *Proc. Amer. Soc. hort. Sci. for 1933, 30 : 113-6.*

374. SWARBRICK, T., AND THOMPSON, C. R. 634.723

A comparison of the picking costs of six commercial varieties of black currants.

Annu. Rep. Long Ashton Res. Sta. for 1934, 1935, pp. 16-23.

Picking was done by women paid on an hourly basis. On the particular plots the bushes of each variety are distributed in randomized groups which results in time being spent in walking between the groups. This renders the cost of picking high, but it remains comparable as between varieties. Tabulated data show crop weights, time taken to pick over 5 consecutive seasons and the cost of picking one ton at 6d. an hour for Baldwin, Boskoop, Davison's Eight, Taylor, French and Edina. The economic value of these varieties as determined by picking costs and crop yields are discussed.

375. CULPEPPER, C. W., CALDWELL, J. S., AND MOON, H. H. 634.75 : 581.14

A physiological study of development and ripening in the strawberry.

J. agric. Res., 1935, 50 : 645-96, bibl. 23.

The physiological changes occurring in developing strawberry fruits were studied over a period of 4 seasons in no less than 12 varieties in the Eastern States. Samples were collected every 5 to 7 days from the time that the petals of the first flowers were still attached until most of the crop was fully ripe. Later samples were subdivided into lots on a basis of size, and, at the end of each season, on colour as well. Very complete chemical analyses were made in all cases, and the data collected therefrom were treated statistically, so as to give an accurate estimation of the sequence of events. The results show that the chemical composition of the crop at any stage is largely determined by the relative activity of two opposed processes, the absorption of water and the accumulation of sugar. The former is normally the dominant process up to the whitening stage, and is determined by the initial soil moisture and the subsequent amount of precipitation; and the latter becomes the dominant process from the whitening stage until full ripeness, and is governed by temperature and the amount of sunlight. Thus, since both are controlled by environmental factors, alterations in conditions may produce temporary fluctuations in the composition of the fruit. The analyses were accompanied by tests to determine the resistance of the fruit to puncturing. Resistance was found to be highest in the earliest stage, and decreased to between one-third and one-fourth at the stage of whitening, when the fruit attains its maximum water and minimum titratable and active acidity contents. Thereafter to full ripeness resistance to puncturing decreases very rapidly. A comparison of the ratios acidity:astringency, acidity:sugar content, acidity:total solids, astringency:total solids, total solids:sugar in the different varieties enabled them to be grouped into 4 groups, namely (1) low sugar, low acid, low astringency group; (2) low sugar, low acid, high astringency group; (3) medium sugar, high acid, medium astringency group; (4) high sugar, low acid, low astringency group. The third group, containing Dunlap, Howard 17, Gandy, Klondike and Missionary, most nearly approaches the type of chemical composition desired for preserving purposes.

376. WINKLER, A. J. 634.851-1.542

Pruning vinifera grape vines.

Circ. Calif. agric. Ext. Serv., 89, 1934, pp. 68, bibl. 9.

This paper contains much material from earlier reports now out of print, to which recent information has been added. The objects and principles of pruning as applied to grape vines are discussed, and an account is given of the various influences of dormant pruning, summer or herbaceous pruning, and thinning upon the plant. The numerous systems in use are classified on a broad basis of a few essential differences. The principal commercial systems, namely head pruning, cordon pruning, and cane pruning are then described in detail from the development of young vines to full maturity. In conclusion a guide to the choice of a pruning system based on the principal local varieties is included, and a note is added on the pruning of grape vines for arbours.

377. DE CASTELLA, F. 634.8-1.67
Vineyard irrigation.
J. Dep. Agric. Vict., 1935, 33 : 137-42.

The principle is put forward here that an avoidance of over-exuberant summer growth with a consequent improvement in yield and quality and an economy in working may be obtained by a restriction of the soil moisture content at a period of the vine's most rapid growth in late spring. This can, of course, only be brought about in irrigated districts. The advantages of a reduction of soil moisture in spring are that it favours blossoming and the differentiation of fruit buds for the following season, facilitates disease control, reduces liability to sun scald in late summer and improves the quality and weight of the current season's fruit. Suggestions for the number and approximate times for irrigations on good vine land in Victoria are given.

378. YEDIDYAH, S., AND VABOLSKI, N. 634.51-1.541.11
A trial in walnut growing at Mikveh-Israel. [Hebrew-English summary.*]
Publ. Agric. School Mikveh-Israel, Horticulture, 5, 1935, pp. 10, bibl. 7.

Experimental material consisted of Mayette, Franquette and Commune seedlings from Italy, local seedling varieties on their own roots and worked on to *J. nigra* and the Californian varieties, Placentia and Eureka, grafted on *J. nigra*. After 11 years' growth the following facts are established. Under local conditions the leaves and branches of Mayette and Franquette suffer badly from sunburn. The nuts of these varieties are not always true to type. The local seedlings are all hard shelled. Selected seedlings grafted on *J. nigra* have produced nuts true to type and have started to bear earlier than those on their own roots. Placentia seems admirably suited by the climate and has borne large, thin-shelled nuts at an early age. Considerable variation is noticeable in *J. nigra* seedlings raised locally. Only a small percentage form a good union with Placentia. Whip and cleft grafting in nursery and plantation have proved very successful, as also patch grafting, especially when the union is covered with melted paraffin. Shield budding has proved quite unsuccessful in the nursery.

379. ANAGNOSTOPOULOS, P. T. 634.574
The pistachio nut tree in Greece. [Greek-English summary.]
Publ. Sup. School Agric. Athens, 1935, pp. 125, bibl. 27.

The very dry climate of Greece admirably suits the growth and pollination of this tree and the proper ripening of its fruits. The biennial habit is usual but is thought to be due to lack of inorganic fertilizer, the appropriate addition of which should induce annual bearing. It is normally budded or grafted on to wild or seedling trees, and notes are given on the proper times for and methods of executing these operations. The incidence of pests and diseases is discussed and space is devoted to control measures successfully adopted.

PLANT PROTECTION OF DECIDUOUS FRUITS.

380. KESSLER, O. W. 634.8-2.111
Frostschadenbekämpfung. (Frost protection. Investigational results in the vineyard up to the spring of 1935.)
Repr. Dtsch. Weinbau, 1935, pp. 135-6, 164-7.

The author considers possible anti-frost measures under three headings, namely (1) improvement of climatic conditions, (2) smoke and gas clouds, (3) orchard heaters. Considering an actual named vineyard, which normally suffers severely from frost damage he indicates how climatic conditions could be improved by changing certain natural features. His suggestions include the removal of a strip of wood which at present bounds the vineyard at its lowest point and so

* Full translation available.

makes it into a frost pocket. The hedges standing at present above the vineyard should be replaced by forest plantations and in addition another source of frost, a marshy area close to the vineyards, should be drained. Windbreaks are necessary at one indicated side of the vineyard. The formation of storage ponds at the lowest part of the valley just below the vineyards is also recommended, as such ponds should ensure a considerable warming of the cold air. The efficacy of smoke and gas clouds depends on the fact that both tend to check loss of heat by radiation. These methods are suitable only for flat country in the absence of wind and given such circumstances they have proved very successful. For German vineyard conditions heating affords much the surest protection. Owing to the excessive cost of raw oil in Germany heating is generally done with brown coal briquets which are burned in funnel shaped heaters, the wide end topmost having a holding capacity for about $\frac{1}{2}$ cwt. of briquets. Wood wool soaked in naphthaline serves as kindling. The heaters are set at 7×7 m., which is equivalent to 1 heater for every 50 square yards on large rectangular areas and rather more closely together on smaller or irregular areas and on the side which the frost is likely to attack first. On nights when there is danger of frost all except 6 briquets are removed from the heater (which may serve for their transport) and heaped at the side. If the temperature falls to about 1° F. below freezing point the heaters are lighted. In normal frosts about 4 briquets must be burned per hour but in the case of severe frosts 6-8. These heaters have been found extremely useful in practice. Their cost, inclusive of labour, kindling and briquets, if heating is carried out for 3 hours on 3 consecutive nights, taking the life of a heater as 10 years and its cost as 1.8 RM, 14 briquets being used per night, works out at 45 RM per morgen, or at present rate of exchange £6 per acre. The article contains illustrations of the heaters as also of straw and paper frost protectors for vines, which have, however, not proved very successful.

381. FUESZ, J., AND SCHNEIDERS, E. 634.8-2.111
 Ueber Wirkungen und Schäden der Maifröste 1934 an Kober 5BB-Reben.
 (Damage done by frost in May, 1934, to an American vine rootstock.)
Gartenbauwiss., 1935, 9 : 353-63, bibl. 4.

Investigations have shown that although the young shoots of frost damaged vines may apparently recover they have very frequently suffered damage both to the diaphragm bridges and pith of the young shoots, resulting in improper ripening of the wood. If later these shoots are worked with scions, the chance of a successful and enduring union is seriously enhanced. Hence the advice is given that all young shoots damaged at all by frost should be resolutely cut back. Sufficient new growth will in all probability be formed to furnish adequately ripened graft wood. Comparative trials are now in progress on the after effects of frost damage on worked vines.

382. STEELE, T. A., AND OTHERS. 634.75-2.111
 Conditions affecting cold resistance in strawberries.
Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 434-9.

The results of a number of tests showed that the strawberry varieties, Corvallis, Blakemore, Redheart, and Narcissa were more resistant to freezing injury than Marshall, Ettersburg 121, and Wickson. Plants kept in cold frames at winter temperatures which ranged from a mean of 58.6° F. in September to 46.8° F. in December were more resistant to artificial freezing than similar plants kept in a greenhouse at temperatures of 65 to 68° F. Plants grown in dry or medium dry soil were more resistant than plants grown in well moistened or wet soils. A sudden drop in temperature was more detrimental than a gradual decline. For the first 6 and 10 hours exposure at 18° F. little injury was recorded in plants from either the greenhouse or cold frames, but after that period the longer the freezing continued the greater was the damage done. Vigorous well-rooted plants, which have not fruited are less injured by freezing temperatures than plants which have borne fruit, or young runner plants, which have not developed good root systems. Root injury was not considered to be as important in any instance as injury to the upper portions of the plant.

383. GARDNER, V. R. 634.23-1.547.5 : 632.111
Susceptibility of flower buds of the Montmorency cherry to injury from low temperature.
J. agric. Res., 1935, 50 : 563-72.

The Montmorency cherry is subject to winter killing in U.S.A. at 3 different stages, viz. while dormant, soon after growth has begun within the bud in spring, and in the pre-blossom or blossom stage. There appears to be no close correlation with the degree of development attained by the bud, so that cultural methods designed to hasten or delay differentiation are not likely to have much effect in preventing frost damage. Susceptibility to injury from low temperatures at one of these stages is not correlated with susceptibility at any other stage. There is also a marked difference in susceptibility to cold between trees and even between branches on the same tree. A type of winter killing is described which the author thinks has not yet been noticed in literature dealing with the sour cherry. He calls it delayed winter killing. The buds, in which some individual flowers have been killed but others survive, swell, much as undamaged buds, to several times their winter size and reflex their outer and expand their inner scales without protruding any blossoms. The outer surfaces of the inner bud scales become a purplish pink and at full blossom stage these buds, that apparently promised a full crop, fall off.

384. ATKINSON, J. D. 634.11-2.1
Progress report in the investigation of corky-pit of apples.
N.Z. J. Sci. Tech., 1935, 16 : 316-9, bibl. 2. *Orchard, N. Z.*, 1935, 8 : 6 : 10-2.

Salts of some 16 different minerals were injected in weak solutions into trees which had shown a high proportion of apples infected by corky-pit. The fruits at the time of injecting were $\frac{1}{2}$ "- $\frac{3}{4}$ " in diameter. At harvest all fruits were cut open to differentiate those showing any disease at all and those showing none. Trees of Granny Smith and Jonathan injected with boracic acid showed practically no infection, but the incidence of disease in all other cases was very high. This would appear to indicate that corky-pit is materially influenced by the addition of boron.

385. ASKEW, H. O. 634.11-2.1
The boron status of fruit and leaves in relation to "internal cork" of apples in the Nelson district. A preliminary report.
N.Z. J. Sci. Tech., 1935, 17 : 388-91, bibl. 4.

The condition known as "internal cork" or "corky-pit", has been correlated with different soil types. It is noted that Rigg and Tiller associate it with low rainfall, waterlogging, bad cultural conditions and high stimulation of leaf development. The boron content of apple fruits and leaves of three varieties, Jonathan, Dunn's Favourite and Dougherty, collected from healthy trees and from trees affected with internal cork, was determined on several soil series. It was found that apples affected with internal cork had about $\frac{1}{3}$ of the amount of boron found in healthy apples. The percentage of boron found in different samples was inversely proportional to the severity of the attack. These results when viewed in conjunction with Atkinson's results [see Abst. 384.—Ed.] with boron injection of trees suffering from internal cork suggest that boron deficiency is the primary cause of internal cork of apples in the Nelson district. J.H.

386. VOORENDYK, J. J. 632.183
Planting trees for special purposes. IV. Wind-breaks as a necessity in the production of garden, orchard, and field crops.
Fmg. S. Afr., 1935, 10 : 256-7, 268.

The author outlines the adverse effects of winds with particular reference to climatic conditions in South Africa where in almost all regions the conservation of moisture is of great importance. The general advantages and disadvantages of wind-breaks are noted, and in conclusion a list of trees recommended for the purpose is supplied. For single-row planting, when the spacing should be about 6 feet, the following species are suggested :—*Cupressus arizonica*, *C. lusitanica*, *Pinus halepensis*, *Juniperus virginiana*, *Populus alba*, *P. nigra*, *Eucalyptus cinerea*, *E. melliodora*, *E. polyanthemos* and *Acacia Baileyana*. For belts of more than one tree spacing could be 6-8 feet in the rows and 8-10 feet between rows. For double rows the following examples of

combinations are given :—*Eucalyptus rostrata* supported by *Cupressus arizonica*, *Populus alba* by *Acacia Baileyana*, *Casuarina Cunninghamiana* by *Pinus halepensis*, and *Eucalyptus sideroxylon* by *Callitris robusta*. A treble row is usually regarded as fulfilling an ideal condition. In this case the middle row should consist of tall and rapid-growing trees with a light crown flanked on either side by trees with heavier foliage. Examples are :—inside row *Cupressus torulosa*, middle *Eucalyptus crebra*, outside *Cedrus deodara*; or inside row *Dodonea viscosa*, middle *Eucalyptus cladocalyx*, outside *Ceratonia siliqua*.

387. TRUFFAUT, G. 632.3/8
 La chimiothérapie des maladies des végétaux. (**The chemotherapy of plant diseases.**)
Publications des Laboratoires, Georges Truffaut, 90^{bis} Avenue de Paris, Versailles,
 pp. 15.

The author briefly discusses the chemotherapy of dyestuffs in relation to diseases of man and animals, at the same time pointing out that these materials have been almost completely ignored by phytopathologists. After describing the usual lines of attack on plant diseases, he considers the possibility of applying dyestuffs and intermediates for this purpose. The three factors to be considered are the specific activity of the material, its physical properties, e.g. ability to penetrate plant tissues, and its cost. An experimental technique is described consisting of coating sheets of glass with a nutrient medium, solidified by the addition of gelatine, containing the desired concentration of the material under examination. The plates are then infected with *Penicillium glaucum* or *Rhizopus nigricans*, these being selected as suitable resistant organisms. Malachite Green is found to be one of the most effective anticyptogamics, while many dyestuffs of outstanding value in the treatment of animal disease are useless. Since dyestuffs can be applied to vegetation only by drenching or spraying, the physical factors of wetting, spreading and sticking are of primary importance. The phenomenon of surface tension is discussed and shown to be responsible for the inability of water to wet foliage etc. The addition of bodies such as alcohol, glycerine, soaps and their derivatives, and various sulphonated organic materials, reduces surface tension, promotes wetting and so allows the dyestuff to come into contact with the parasitic organism. On account of the difference in chemical constitution the hyphae etc. of the parasite take up basic dyestuffs, whereas the cellulosic material of the host remains unstained. It is shown that penetration is largely dependent on the fat and lipoid solubility of the material, so that oil soluble substances, including basic dyestuffs, are in general more active than substances readily soluble in water, including sulphonated dyestuffs. It is essential that any agent added to reduce tension should not in any way inactivate the dyestuff, e.g. by precipitation or modification of solubility. Substances are available which are stable in presence of acids, alkalis or hard water. The author and his colleagues have investigated various series of dyestuffs and, in parallel, various wetting agents. Methods of chemical analysis and determination have been worked out and problems of compatibility solved. As a result of this work, two new types of fungicidal products have been elaborated—the “*Héliones*” intended for application during growth, and the “*Elgétols*” for use during the dormant period. Both are coloured products containing neither copper, arsenic nor mercury. The *Elgétols* are also insecticidal. The use of these materials in practice is then described. A 1% solution of *Elgétol* yellow used as a dormant spray will control fungi, rid the trees of hibernating insects and of moss and algae. This spray should not be used in summer. The *Héliones* are effective seed fungicides and accelerate germination. They are useful also for the protection of bulbs and seedlings. The specific action of various *Héliones* is then described. The author states that the studies here described are but the first steps in the new science of plant chemotherapy—and that there is great promise for the future. H.S.

388. OTERO, J. I., AND COOK, M. T. 632.8 : 016
Partial bibliography of virus diseases of plants.
J. agric. Univ. Puerto Rico, 1934, 18 : 5-410.

This very comprehensive bibliography contains reference to some 4,000 articles dealing with virus diseases. The compilers state, however, that many anonymous papers, and bulletins of a

purely popular character, together with reports containing no new data and a number of old out-of-date papers have been omitted. Hence the use of the qualifying term "partial" in the title. The references are arranged according to authors in alphabetical order, and in the case of papers which appear to be of more importance short notes as to the contents are appended. It is perhaps rather unfortunate, however, that no classification is included, based upon the particular plants and their specific diseases, such as is found in Atanasoff's *Virus diseases of plants. A bibliography.* (H.A., 1934, 4 : 3 : 494.)

389. LANGORD, L. R. 634.23 : 581.144.2
Cherry leaf curl and root injury.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 252-3.

Preliminary investigations on a leaf curl of cherries characteristic of a large proportion of the trees growing in the Door county region of northern Wisconsin have indicated that this is associated with root injury. No direct association was found between differences in soil moisture contents and curling. Trees showing leaf curl have a smaller proportion of live feeding roots and fewer large roots than normal trees. Mulching with straw round the trees in autumn reduced curling the following summer, and from this it would appear that the reduction of roots is due to winter injury, particularly as the feeding system of the sour cherry is mostly very shallow.

390. HARTZELL, A. 634.25-2.8
A study of peach yellows and its insect vector.

Contr. Boyce Thompson Inst., 1935, 7 : 183-207, bibl. 34.

Peach yellows is known to affect the peach, nectarine, almond, apricot, and Japanese plum (*P. salicina*). Its distribution is limited to the north and eastern part of the climatic range of the peach in North America, but in this area it is one of the major diseases of the fruit tree. The present paper is the outcome of a number of years' work upon the subject. An account is given of the symptoms of the disease both on young and fruiting trees. All varieties of peach appear to be equally susceptible. Seedlings may develop yellows, but there is evidence from one experiment described here that susceptibility increases with the age of the tree. In this case nearly ten times as many four-year-old trees on which an insect vector was feeding developed yellows as did some one-year-old trees treated in the same way. Investigating transmission it was found that applying diseased pollen and mechanical inoculation were without effect on healthy trees. Yellows was transmitted experimentally, by budding, but the symptoms did not appear until one or more years later. Some 48 insects and mites were tested, but only one was found to transmit the disease. This was *Macropsis trimaculata*, which, compared with other leafhoppers of economic importance, is a rare species. An account is given here of its life history. Yellows was transmitted experimentally by both nymphs and adults, and about 16% of the trees exposed to infected leafhoppers became diseased. The principal host of the insect would appear to be the wild plum, *Prunus Americana*, and a definite connection was noted between the insect vector, the wild plum, and the incidence of the disease. It is not suggested, however, that the plum itself is a source of yellows, but it is important as a host of *M. trimaculata*, in that its range of distribution extends over and beyond the peach growing area. The author considers that the removal of wild plums from the vicinity of peach orchards combined with the roguing of diseased trees would do much to check the disease.

391. PITTMAN, H. A. 634.37-2.1
Fig leaf mottle.
J. Dep. Agric. W. Aust., 1935, 12 : 196.

A mosaic disease known as fig leaf mottle is prevalent and increasing in Western Australia. It is accompanied by some distortion of the leaves and frequently results in an entire loss of the first and a partial loss of the second crop. It has been found that a considerable improvement can be brought about by the addition of 1-4 lb. of finely crushed copper sulphate to the soil beneath the tree. It should be applied all round the tree at a distance of 1 ft. from the trunk to as far out as the radius of the branches at any time of year provided that the soil is moist.

One-fourth the amount of the first application should be added each autumn. No great quantity should be allowed to rest at any one spot or injury may result. A fine crystalline form "bluestone fines" requires no extra grinding before distribution.

392. OGILVIE, L.

634.11-2.4

The fungus flora of apple twigs and branches and its relation to apple fruit spots. I. Review of literature and preliminary experiments.

J. Pomol., 1935, 13 : 140-8, bibl. 36.

The author considers in turn the fungi parasitic on living twigs and branches and those saprophytic on dead tree material. He concludes from evidence produced in this country and elsewhere that much of the infection of apple fruits can be traced to the twigs and branches. The experiments of Horne and others have indicated that apple rots in store are due to a large extent to fungus infection in the air while in the orchard. It is suggested that the practice of removing dead twigs, old bits of broken branches and mummied fruits together with routine spraying helps to mitigate fruit infection. [To be effective, however, it would appear necessary for these hygienic methods to be applied over a wide area, as Horne's experiments were carried out in extremely well cared for orchards, yet the air was thick with spores.—ED.] In orchards where some of the fruit spotting fungi are prevalent, cankers and dead wood should be cut out, and a special summer application of bordeaux may be advisable for varieties not injured by bordeaux.

393. THOMAS, H. E., AND ARK, P. A.

634.13-2.314

Fire blight of pears and related plants.

Bull. Calif. agric. Exp. Sta., 586, 1934, pp. 43, bibl. 73.

Fire blight caused by *Bacillus amylovorus* with particular reference to pears is the subject of this comprehensive study. The blossom is the usual site of infection, although actively growing wood is also subject. Both shrivel and darken in colour as though scorched by fire. A characteristic milky to brownish sticky gum often exudes from blighted parts. Overwintering of bacteria is in cankers ultimately formed on branches, stem or roots. A great many rosaceous plants are susceptible including pear, apple and quince, but infection is rare in the apricot, cherry and plum. Studying many plants and beehives as possible sources of spring re-infection the writers conclude that the pear tree itself is the source of bacteria, by which it is infected in the great majority of cases. Most of the evidence available supports the theory that various insects are responsible for this dissemination, carrying bacteria from last year's cankers to the blossoms, and then from blossom to blossom. The spread, however, appears in general to be restricted to a cankered tree and one or two trees in the immediate neighbourhood. Wounds made by tools do not often seem to become infected except in the case of newly damaged roots. The question of control is discussed. Attempts are being made to raise pear varieties and rootstocks immune to the disease. Spraying with bordeaux mixture has so far yielded very erratic results. Attempts to use bacteria antagonistic to blight organisms have up to the present proved unsuccessful. Cultural practices inducing vigorous tree growth favour bacterial development and may be modified, though not neglected, with advantage. Cultivations liable to injure roots should not be done within three days of impending irrigation. Methods of scraping or scarifying cankers followed by applications of mercuric chloride or mercuric cyanide are recommended. The application of a penetrating chemical solution to the uncut surface of cankers is also discussed. In conclusion the authors provide a recommended seasonal programme for blight treatments.

394. ANON.

632.42 : 634.22

Brown rot and allied diseases of plums.

Advis. Leaflet. Minist. Agric., London, 1935, 248 : pp. 4.

A brief description of brown rot and allied diseases of plums caused by *Sclerotinia fructigena* and *S. laxa* is followed by recommendations for control. More detailed information may be found on this subject in *Bull. Minist. Agric., London*, 88, 1935, H.A., 1935, 5 : 2 : 325.

395. NATTRASS, R. M. 634.63-2.3/4

Disease of the olive.

Cyprus agric. J., 1935, 30 : 55-7.

Four diseases are briefly described :—(1) The leaf spot or blotch caused by *Cycloconium oleaginum* is rarely serious, but can be controlled by spraying with bordeaux mixture, first before flowering and secondly after the fruit is picked. Field sanitation is also recommended. (2) The sooty mould or fumagine is not in itself a disease of the leaves and needs no control. (3) *Macrophoma dalmatica* may cause disease of the fruit. Recommended methods of control as for leaf spot. (4) The olive knot or gall, bacterial and probably the most important disease of the olive. No direct treatment is known. Nursery trees should be carefully inspected and trees with galls destroyed, and in groves twigs and branches showing galls cut out during dry weather in the summer. As precautions branches which rub should be removed, and at picking care taken to avoid injury to the trees.

396. HAMOND, J. B. 634.51-2.48

The morphology, physiology and mode of parasitism of a species of *Chalaropsis* infecting nursery walnut trees.

J. Pomol., 1935, 13 : 81-107, bibl. 10.

Four strains of a species of *Chalaropsis* fungus have been isolated from a walnut graft, walnut root, carrot and peach respectively. All bear a close morphological resemblance, and a series of inoculation tests between the two regions of the walnut and carrots indicate that only one fungus is concerned. The carrot strain was, however, the most virulent as a parasite of carrots. Furthermore inoculations of culture suspensions into lupins proved positive, and it would appear very probable that the fungus in all these cases is *Chalaropsis thielavioides*, described by Peyronel in 1916 as a parasite of lupins in Italy. Detailed accounts of the morphology and physiology of the strains found on walnuts are given in this paper. In 1930 there was an almost complete failure of walnut grafts at East Malling Research Station. About three weeks after grafting the buds on the grafts instead of growing began to fall off. In 1932 an unhealthy young tree failed to come into leaf and was excavated, and the tap-root was discovered to be black and disintegrating. The walnut root strain of the fungus was found to be responsible. Experiments were instituted on possible control measures, and as a result weak formalin has been adopted as a routine treatment for *Chalaropsis* at East Malling. Satisfactory results have been obtained with 1 part commercial formalin (40% formaldehyde) to 39 parts water. The greenhouse is sprayed thoroughly each spring before grafting commences. Formalin is also used for treating cut surfaces, which are formed when rooted layers are removed from the parent stool before planting and also on the cut surfaces of seedling stocks, when these are trimmed before potting. Inoculation tests have shown, however, that formalin does not give complete control in either of these cases.

397. COLBY, A. S. 634.725-2.4

Inheritance of gooseberry leaf infection.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 397-9, bibl. 1.

Percentages of leaf infection with anthracnose and leaf spot rated as light, medium, and heavy were formulated for 1301 gooseberry seedlings representing progenies of each of nine crosses and selfs. Indications are that the parent, Transparent, carried the largest number of factors for resistance. The same appears to apply to some extent to Carrie, Como, and Rideau, but Poor-man, Glendale, Oregon Champion, Downing, and Minnesota No. 96, when either crossed or selfed, were not so promising.

398. BROOKS, F. T., AND BRENCHLEY, G. H. 634.22-1.541.11-2.47

A note on the recovery from silver-leaf disease of plum trees on common plum and myrobalan stocks respectively.

J. Pomol., 1935, 13 : 135-9.

The results of two investigations are discussed here. In the first 5-year-old trees of Victoria plum worked on common plum and myrobalan stocks were inoculated in March with a uniform

spore-suspension of *Stereum purpureum*. Three of the larger shoots in each case were treated in this way, and three months later all shoots were silvered to about the same extent. Unfortunately bacterial canker caused the death of several trees, but the effect of silver leaf on the remaining trees was considered to be sufficiently striking to merit attention. Out of 13 trees on myrobolan 11 were silvered and 4 of these died, whereas out of 15 trees on common plum only 3 were silvered, and none of these died. Confirmatory data were obtained from another plot at East Malling Research Station in which some five varieties in various numbers were worked—actually for the purpose of rootstock investigations ED.—on these two stocks among others. Severe natural infection by *Stereum purpureum* took place and records of its effect were kept for ten years. No significant difference was found between the numbers of trees on each stock infected, but the proportion of trees which had recovered by the end of the period was just significantly greater on common plum. The value of these results would, however, have been greater, if the varieties on each stock had been present in equal proportions.

399. WILSON, E. E.

634.63-2.314

The olive knot disease : its inception, development, and control.

Hilgardia, 1935, 9 : 233-64, bibl. 26.

Olive knot, caused by *Bacterium savastanoi* has become a serious disease in California during recent years, where no varieties have been found to be immune. As regards dissemination there is evidence from the present investigations that over long distances infected nursery stocks and pruners are most likely to be responsible. For instance it seems probable that bacteria on the blade of a pruning knife will survive for three hours or more, even when exposed to direct sunlight. There is no evidence that birds or insects commonly transmit the disease. Downward spread in the orchard is held to be largely caused by rain. Exudate may appear on knots a few minutes after they are wettened. Lateral spread in the orchard would seem to be influenced by wind-borne rain, and thus prevailing winds may be of importance. The main period of infection was mid-winter during the longer rainy spells, but inception may occur to some extent at any period of the winter and spring, temperature having little effect. Rapid drying of shallow wounds reduced incidence, but had little influence on deep wounds. A wound of some sort appears to be essential for entry of the bacteria. Freezing injuries, pruning wounds, bark cracks produced by the emergence of suckers, and leaf, blossom, and raceme scars were all found to be points of entry. In ordinary years leaf scars provide the commonest means of infection. Scars formed in the spring are not, however, infectible during the following autumn, so that it would appear only to apply to leaves falling in autumn or winter. The most satisfactory control has so far been achieved by the use of home-made bordeaux in three applications during the autumn, winter and spring. Strength 4, 4, 50 would seem to be sufficient, and with stronger solution there is increased danger of defoliation and consequently more points for infection. Some other sprays gave partial control, but none were so effective. The removal and destruction of knots may be of use only in so far as it does not preclude the production of an increased number of wounds. The author suggests that this practice should be limited to removing dead or much weakened branches as a whole, the few wounds so made to be covered with a protective material such as bordeaux paste. A suggestion that fertilizers may be of advantage in increasing the trees' resistance is not considered likely to prove of much benefit.

400. MORGAN, A.

632.954

The absorption and translocation of herbicides.

J. Dept. Agric. Vict., 1935, 33 : 200-8, bibl. 49.

The paper is chiefly concerned with the destruction of weeds which have a root development and carbohydrate storage apparently out of all proportion to their top growth. Weeds of this type are very resistant even to frequent tillage. Three main chemical methods of attack are available, namely, soil sterilization, toxic gas production in the soil, and remote penetration of sprays. For effective soil sterilization the herbicide must penetrate to a depth below that at which the plant can produce new shoots capable of reaching the surface, and must be of sufficient

persistence to kill off a succession of buds and root hair growth. The disadvantage of this is that crop production on treated areas must be much delayed. Sodium chlorate and common salt are useful soil sterilizing agents. Toxic gas production is effective if the soil is sufficiently permeable to allow the gas to reach the necessary depths and provided the toxic concentration can be maintained from this depth to the soil surface. The most satisfactory of this group is carbon bisulphide, which does not permanently harm the soil solution or micro-organisms. The cost of material alone, however, is ten times the cost of eradication by cultivation (in Australia). The remote penetrant group appears to present the most possibilities of useful development. It is necessary for them when sprayed on the plant to be absorbed in the vascular system and carried down to the roots. Arsenical compounds, chlorates and ammonium thiocyanate possess this property. Factors governing the efficiency of remote penetrant sprays are discussed in the form of a review of the somewhat extensive work which has been done on this subject, including the experiments at the State Research Farm, Werribee.

401. TRUFFAUT, G., AND PASTAC, I. 667.21 : 632.51
L'action selective des matières colorantes sur les végétaux. (**Selective action of dyes on plants.**)
14^{ème} Congrès de Chimie Industrielle, Paris, 1934, publ. by Chimie et Industrie,
28 Rue Saint-Dominique, Paris.

It has been found that certain chemical dyes (not specified) in weak solution will destroy certain weeds such as charlock and thistles in fields and lawns without injury to the cultivated crops, the dyes in fact partially sterilizing the soil and so often increasing yield. The action of these dyes does not cease when they enter the ground but germinating seeds of the weeds are destroyed for some time afterwards. The younger the weeds to be destroyed, the weaker and consequently the cheaper will be the solution needed. Poppies and buttercups are unaffected but possibly dyes may be found to which they also are susceptible.

402. ANON. 632.6/7
Insect pests and their control.
Agric. Gaz. N.S.W., 1935, 46 : 394-8.

Of the six pests briefly discussed here, four are of horticultural significance. The pear-leaf blister mite, *Eriophyes pyri*, can be controlled by 1 in 10 lime-sulphur applied preferably in late autumn or early spring. San José scale, *Aspidiotus perniciosus*, attacks apples, pears and quinces and less commonly peaches, plums and almonds in N.S.W. Recommended sprays are 1 in 20 miscible red oil or lime-sulphur at winter strength. The woolly aphid *Eriosoma lanigerum*, is often effectively controlled by the small wasp parasite, *Aphelinus mali*. In some seasons, however, it may be desirable to spray, and 1 in 20 miscible red oil is recommended for winter application. In addition prunings bearing parasitized woolly aphids should not be destroyed, but should be stacked to let the wasps emerge in the spring. The citrus gall wasp, *Eurytoma fellsis*, is particularly troublesome on lemons and grapefruit. The only control is the removal and destruction of galls. This is best done in winter, but not later than August so as to avoid the emergence of adults.

403. MORRIS, H. M. 634.63-2.7
Olive pests.
Cyprus agric. J., 1935, 30 : 54-5.

The life histories of and control methods for the following pests are outlined :—(1) The olive fly, *Dacus oleae*. A poison bait containing an attractor (unspecified), a small quantity being sprayed monthly on to each tree during the summer is suggested. (2) The olive moth, *Prays oleellus*. May be controlled by arsenical sprays and autumn cultivation to bury pupae. (3) The olive twig beetle, *Phloeotribus oleae*. The best control is thorough and regular pruning, the prunings to be burnt. Spraying with a stomach poison, HCN fumigation, and the use of bunches of olive twigs as traps may help to some extent. (4) The olive weevil, *Rhynchitis ruber*. Winter

cultivation will destroy many pupae. Lead arsenate or paris green sprayed in the late spring and the collection of adults by shaking the trees over sheets will afford further control. The collection of fallen olives and their destruction is helpful in the case of attacks by fly, moth or weevil.

404. DUMBLETON, L. J. 632.771 : 632.96

Further note on pear midge parasite.

N.Z. J. Sci. Tech., 1935, **16** : 339-41, bibl. 3.

The larvae of the pear midge in New Zealand are parasitized by a species of *Misocyclops*, possibly *M. marchali* or a hitherto unrecorded species. Investigations during the 1934-35 season revealed considerable differences in the number of larvae parasitized, and the results taken in conjunction with previous data show that from season to season, from brood to brood, and under different local conditions, marked fluctuations in the degree of parasitism may be expected. So far, however, no records are available of the degree of parasitism in relation to midge population as a whole, and further work will be necessary before the usefulness or otherwise of *Misocyclops* can finally be established.

405. BOYCE, A. M. 632.77 : 634-51

Bionomics of the walnut husk fly (*Rhagoletis completa*).

Hilgardia, 1934, **8** : 363-579, bibl. 39.

This paper is in the nature of a summary of many investigations carried out in connection with this insect pest in California over a number of years past, together with a very comprehensive account of the insect itself, its life history, habits, and the nature of the injury it causes to the walnut. The experiments and tests recounted, deal principally with host resistance as related to hardness of the husk, and with control measures. (See also *H.A.*, 1934, **4** : 4 : 574, 575.)

406. GRAY, R. A. H., AND BROOKS, H. E. 633.711-2.76

Spraying trials against the raspberry beetle (*Byturus tomentosus* Fab.).

J. roy. hort. Soc., 1935, **60** : 339-41.

The insecticides used were derris, barium silicofluoride, and nicotine. All three were applied as sprays and the first two also in the form of dusts, one, two or three applications being made. All gave partial control, but none complete. Nicotine is considered to have been the least satisfactory, but from the account of the trial it would appear that it was hardly tested to a sufficient extent to merit any very definite opinion. Liquid derris gave the best control, and two applications, one during the opening of the buds, and the other when the petals were falling, proved every bit as satisfactory as when a third application was sandwiched in between the other two. Combinations of dusting and spraying gave consistently inferior results.

407. COTTIER, W. 634.11-2.654.2

Red-mite control by oil-sprays.

N.Z. J. Sci. Tech., 1935, **16** : 261-70.

A series of twenty petroleum oils, differing mainly in their viscosity and in the type of emulsifier used, were tested to determine their destructive effects on the winter eggs of two common species of red mite, *Paratetranychus pilosus* and *Bryobia praetiosa*. Infected apple shoots were cut off and examined. Suitable locations of eggs were ringed with ink, and the numbers of eggs recorded. During the experimental period the shoots were kept in pots of sand. The oils were applied by dipping the shoots twice in the requisite mixture, controls being dipped in water. For this purpose the unit was taken to be about 200 eggs to each treatment, although later insufficient eggs of *P. pilosus* were found to make this possible. Estimations of mortalities were begun about two months later, and showed that the winter eggs of *P. pilosus* are less easily destroyed by petroleum oils than are those of *B. praetiosa*. Unstable emulsions were more effective than stable, especially in the case of *P. pilosus*, and even an increase in the viscosity of an oil in a stable emulsion may not necessarily give a satisfactory kill of this mite.

408. ANON. 632.951.8 : 634.1/7
New oil emulsions for winter spraying fruit trees.
Fmg. S. Afr., 1935, 10 : 304.

The use of raw linseed oil is being superseded by seal-oil and whale-oil in the Western Cape Province. A 5% solution is normally employed, and for deciduous fruits the best time to spray would appear to be 4-6 weeks before blossoming is due to begin. Seal-oil in particular gives excellent control of scale and gives satisfactory results when used against woolly aphids and bryobia mite. Methods of preparing the emulsions are given.

409. STRICKLAND, A. G. 632.951.23 : 634.11 + 634.13
The removal of spray residue from apples and pears.
J. Dept. Agric. S. Aust., 1935, 38 : 836-8.

The use of white oil as an adjunct to lead arsenate sprays, especially as a substitute for the final application, reduces the arsenical residue on the fruit. Unfortunately, however, the reduction is not always sufficient to obtain a residue below the legal minimum, and in these cases subsequent cleaning is made more difficult by the presence of the oil. Where this is liable to occur and pending the results of experiments, the writer urges that the use of oil be discontinued. The addition of 1-2 lb. hydrated lime per 100 gallons lead arsenate spray facilitates subsequent removal of residue. The method of cleaning advocated is washing in dilute hydrochloric acid, a strength of 1-3 gallons commercial, approx. 33% acid, per 100 gallons water being suitable for apples and pears. The strength used will depend on the lightness or heaviness of the deposit. The solution is put into a wooden trough, and the fruit is sorted, damaged or diseased specimens being discarded, and is placed in shallow slatted boxes with loose fitting covers. The boxes are plunged up and down in the solution for 2 minutes in the case of 1% acid, and 1 minute in 3% acid. They are transferred to a draining board for 1 or 2 minutes, and then plunged into a second tub containing water. Thorough rinsing is very important. When still water has to be used for rinsing 200 gallons is sufficient for 50 cases, and it should then be changed. The acid solution lasts longer, 50 gallons at 1% being sufficient for 300-400 cases. Between renewals of solution disinfection of containers with weak formalin against mould spores is advocated.

VEGETABLE GROWING.

410. ANON. 631.588.1 : 631.462
Soil sterilisation.
Rur. Electr., 1935, 11 : 85.

Two methods of using electricity for soil sterilization are mentioned. In the first the heating elements are fitted permanently into the soil container, and thus all soils can be treated similarly regardless of their type or moisture content. In the second method, known as the resistance type, the soil itself carries the current. The heating of the soil mass is always even throughout, and initial and running costs are lower, but the time taken and the current used depend upon moisture and soluble salts content in each case. The measurements of a sterilizer of this type from Ohio University are 36 in. x 24 in. x 10 in., capacity 5 cu. ft.; maximum current required to give a soil temperature of 210° F. is between 5 and 10 Kw., attained in 1-2 hours with the soil just moist so as to be easily workable. If the soil near the electrodes dries out, the current flow virtually stops. Hence the sterilizer is semi-automatic. In some soils the process can be accelerated by increasing the soluble salts present by additions of 1/40th to 1/20th of 1% ammonium sulphate or potassium chloride.

411. SECRETT, F. A. 631.67 : 635.1/9
Irrigation for horticultural market crops.
J. roy. hort. Soc., 1935, 60 : 294-303.

The author urges that more use should be made of irrigation in the cultivation of market garden crops in England. He describes the system of overhead watering used on his own farm, and mentions the possible advantages of an aeration plant designed to increase the amount of oxygen present in the irrigation water, and a solutionizing plant in which small quantities of soluble

chemicals may be added. The relationship between watering and the use of fertilizers is also outlined, and particular stress is laid upon the value of organic manures. The paper concludes with a discussion of the right and wrong times and methods for irrigating, and some of the effects noted on various crops.

412. OGILVIE, L., AND OTHERS.

635.1/7-2.4

Progress report on vegetable diseases. VI.

Annu. Rep. Long Ashton Res. Sta. for 1934, 1935, pp. 175-90, bibl. 14.

The report deals with investigations on vegetable diseases in the Bristol Province during 1933-4. No asparagus rust appeared during 1934. Field trials showed that the form of violet root rot, *Rhizoctonia crocorum*, occurring on asparagus can attack carrots, garden and sugar beets, mangolds, parsnips and potatoes. Affected plants showed a premature yellowing of the foliage with copious mycelium on the roots. The injury to carrots was very severe. Red clover, dwarf beans, turnips, peas, and brussels sprouts were not affected. Individual plants of dwarf French beans, particularly some of a slightly different habit of growth, showed exceptional resistance to foot rot (*Fusarium Solani* var. *Martii* (App. et Wr) Wr.). The resistant seedlings were 9 inches high compared to the 4 inches of normally infected plants and their presence materially increased the crop weights. The best disease resistant variety was Flageolet St. Andrew which, like the seedlings mentioned above, develops adventitious roots above the lesions. Soft rot of celery was spread by carrot fly larvae, slugs and the larvae of the *Drosophilid* fly, *Scaptomyza graminum* Fall. The winter lettuces most resistant to *Botrytis* were Lees Immense, Arctic, Imperial and Yates Winter White. Evidence could not be obtained that ring spot (rust) of lettuces, *Marssonina panattoniana*, was transmitted on the seed. Mosaic disease was very prevalent on lettuces during 1934. The aphid, *Macrosiphum sonchi*, is suggested as a possible vector. In peas *Fusarium* foot rot (*F. Solani* var. *Martii*) was produced by growing surface-sterilized peas in damp sterilized soil inoculated with this *Fusarium*. Peas grown in uninoculated sterilized soil were not affected. Vegetable marrow mosaic completely disappeared from two fields where it was annually very prevalent, following the removal of plants of *Bryonia dioica* (Common bryony) from the surrounding hedges.

413. MILES, H. W., AND COHEN, M.

632.656 : 631.544

The glasshouse symphyliid and its control.

J. Minist. Agric. Lond., 1935, 42 : 450-7, bibl. 8.

Glasshouse symphyliid is one of many names used to describe *Scutigerella immaculata*, a small white active creature resembling millipedes and centipedes. Its distribution appears to be world wide, and it is known to feed on the roots of a variety of plants. In Britain, however, only glasshouse crops have been affected, notably tomatoes, lettuce, and sweet peas. An attack is typically manifested by "patchiness" in the crop, and the optimum temperature for this appears to be 50-60° F. A number of control measures such as flooding and steam sterilization have at different times been suggested, but the present investigation was primarily designed to test the effectiveness of carbon bisulphide emulsion. Preliminary tests showed that an emulsion consisting of 50% carbon bisulphide and 50% sulphonated castor oil at dilutions 1 in 60 and 1 in 80 killed symphyliids within 15 minutes. Further tests showed that strength 1 in 100 was effective to a depth of 3 inches, 1 in 80 to 6 inches, and 1 in 60 to 10 inches. An experiment was then conducted in a glasshouse, which had been badly affected the previous season. After trenching and forking to 10 inches, 1 in 60 emulsion was applied at a rate of 1 gallon per square yard. Manure was added and the trenches filled in, and a second treatment of 1 in 100 at 2 gallons per square yard was given. Tomatoes were planted within 24 hours, and showed no chemical injury. Examination of treated and untreated plots at weekly intervals for five weeks showed a contrast of 2 to 221 symphyliids present, and marked differences in plant growth. For treatment after planting a half-pint of 1 in 120 emulsion was applied at 2 inches from the stems of plants on another area. This avoided chemical injury to the stems, and when applied three times at weekly intervals, gave sufficient control to allow the plants to become well established. The paper concludes with general recommendations for use of growers.

414. MORGAN, W. L. 632.951.1 : 632.78
Derris root powder. Its place in cabbage moth control.
Agric. Gaz. N.S.W., 1935, 46 : 267-8.

Plutella maculipennis, the Australian cabbage moth, has been effectively controlled (80%) by a dust consisting of 1 part finely powdered derris and 9 parts talc applied at the rate of 1 lb. per 400-500 plants in the early stages of hearting. Treatment is advised every 10 days during the last 6 or 8 weeks of growth. In Australia the cost of treating with lead arsenate dust (equal parts of lead arsenate dust and kaolin) is approximately 25% less than with derris dust and equally effective. Lead arsenate is therefore recommended until the hearts begin to form after which the non-poisonous derris dust should be used.

415. BACHER, T. 635.64
 Dyrkningsforsøg med Sorter og Stammer af Tomater i Væksthus. (**Test of varieties of tomatoes for glass house.**)
Tidsskr. Planteavl., 1934, 40 : 79-104. (Summary *ibidem*, 1933, 39 : 611-3.)

The tests were carried out at Virum. Under best possible conditions varieties of the Ailsa Craig type yielded the best results, but the Kondine type gave the best returns under less favourable conditions. N.E.

416. PARKER, M. M. 635.64-2.415
The influence of soil reaction upon the growth of the tomato plant.
Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 544-5, bibl. 1.

Marglobe tomatoes were planted on a number of plots, in which the hydrogen-ion concentration had been adjusted by applications of hydrated lime to give a range from pH 4.4 to pH 6.8. The plants were pulled shortly before killing frosts started and the individual green-weights recorded to give quantitative indication of growth development. The lowest weights were recorded from plants grown on the more acid plots showing reactions for pH 4.4 to pH 5.0, and in addition the plants were a dull greyish green in colour with limited foliage. Between reactions pH 5.2 to 5.4 there was a significant increase in weight, and the plants were normal in appearance, but still rather smaller than those on less acid soil of reactions, pH 5.5 to 5.7. The greatest average plant weight occurred between reactions of pH 6.2 and pH 6.4, but it was not significantly greater than that obtained between pH 5.5 and pH 6.2. A significant decrease in weight occurred again from plots with reactions over pH 6.7. It is therefore considered that the optimum range of reaction was between pH 5.5 and pH 6.4.

417. HOFFMAN, J. C. 635.64-1.84
The influence of nitrate and ammonium nitrogen on the growth of greenhouse tomatoes in soils of different reaction.
Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 541-3.

The effects of nitrate of soda and sulphate of ammonia on Marhio tomatoes were compared under conditions of different soil reactions, which had been adjusted with ground limestone and sulphur to give ranges for three plots of pH 7.8 to 8.0, 6.5 to 7.0, and 5.0 to 5.5. The data collected represent one autumn crop grown in sterilized soil and two spring crops grown in unsterilized soil. Crop weights, the numbers of fruits, individual fruit weights, and the percentage of first grade fruits were recorded. The indications from these preliminary experiments are that on the whole sulphate of ammonia is just as effective a source of nitrogen as nitrate of soda for soil reactions that may be expected in most greenhouses, except possibly on recently sterilized soils, which are somewhat acidic in reaction.

418. OGILVIE, L. 635.64-2.8
Spotted wilt of tomato and its control.
Annu. Rep. Long Ashton Res. Sta. for 1934, 1935, pp. 170-4, bibl. 12.

The symptoms of this serious virus disease in tomatoes consists of the bronzing of the young leaves in irregular circles and the almost complete cessation of growth. Other plant hosts of

the disease which are often grown in tomato houses are the arum lily (*Richardia africana*) and probably the chrysanthemum. The insect vector of the disease in England is *Thrips tabaci* which finds a congenial breeding place in the flowers of the arum. Lists of plants affected with spotted wilt in England and in California are given. Many of these plants are grown out of doors in England. The thrips also is prevalent outside in the summer so that there is reason to fear that disease may prove troublesome with outdoor tomatoes as well as with those under glass. So far spotted wilt has not proved transmissible through the seed. The disease can be controlled under glass by frequent roguing of diseased plants and by nicotine fumigation or spraying to destroy the thrips.

419. BROWN, H. D., AND PRICE, C. V. 635.64-2.19
Effect of irrigation, degree of maturity, and shading upon the yield and degree of cracking of tomatoes.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 524-8.

The first part of this paper describes a field trial in which the effect of degree of maturity upon yield was determined for the variety Prichard. Picking was done at three-day intervals throughout the season. From half the plants all the fruits were mature when picked, and from the other half green, but nearly mature. All fruits irrespective of size were picked when they had reached the desired stage. The total weights of fruit at the end of the season were approximately the same, but by picking green a definitely greater weight of tomatoes could be harvested at an earlier date. In average weights ripe fruits were rather heavier, particularly in the earlier weeks. The second part of the paper deals with studies in the control of fruit cracking on a small scale. The results indicate that shading plants in the field with cheesecloth reduced the severity of cracking, but did not eliminate it; secondly that applying one-half a gallon of water per plant per day as opposed to no watering increased cracking; and thirdly that the degree of cracking increases with the stage of ripeness of the fruit, although none but fruits in very immature stages are altogether free from cracks.

420. FRAZIER, W. A. 635.64-2.19
A study of some factors associated with the occurrence of cracks in the tomato fruit.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 519-23.

Tomato fruits may crack radially or concentrically, the cracks in both cases usually occurring at the stem end. Concentric cracking is the least common. In these experiments it was most prevalent late in the season, and was severe only during a rainy season following drought. Heavy irrigation throughout the season induced more cracking than was found in dry plots, but most cracking occurred when heavy irrigation followed dry treatment. Light showers were sufficient to produce perceptible increases in cracking through the absorption of external moisture by corky spots or the corky layer of the stem end. The older a fruit became and the nearer to the base of the cluster it was, the more subject was it to cracking. Shading the plants and bagging fruits in muslin or cellophane reduced the amount of cracking. Chemical composition of the fruit and water content considered individually appear to have little effect. As yet definite correlations have not been obtained between each of the above factors and the degree of cracking.

421. McCLEAN, A. P. D. 635.64-2.8
The bushy-top disease of the tomato.
Fmg. S. Afr., 1935, 10 : 302-3.

Bushy-top disease of tomatoes is prevalent in the Eastern Transvaal. The causal agent is a virus with a wide range of host plants which are affected in various manners. These include several solanaceous weeds and tobacco, egg-plant, cape gooseberry, petunia, pepper and potato. The symptoms of the disease on the tomato are here described briefly. So far no insect vector has been discovered, and the means of dissemination are thus obscure.

422. HAWTHORN, L. R. 664.84.63

Cellophane and waxed paper wrappers for storing cucumbers.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 578-82, bibl. 5.

Preliminary tests on wrapping cucumbers in different materials, subsequently keeping them in high air temperatures until the weights fell to 85% of the originals, revealed that moisture-proof cellophane kept the fruits above this level for 26.4 and 35.4 days in two successive seasons compared with 5 and 7.9 days for unwrapped cucumbers, and a maximum of 8 days for the next best type of cellophane wrapper. Waxed paper, introduced in the second year, was not much inferior to moisture-proof cellophane. The disadvantage of the moisture-proof cellophane would appear to be that moisture condenses on the inner surface within 24 hours and remains visible usually for 20 days or more. This humid condition is held responsible for 12% of fruits decaying in the first year and 36% in the second within the time taken for weights to fall below 85%. The numbers decaying in wax papers were less than this, and in the other treatments neither moisture condensation nor decay were noted.

423. HUTCHINS, A. E. 635.63

Morphological relationships in the ontogeny of the cultivated cucumber (*Cucumis sativus* L.).

Tech. Bull. Minnesota agric. Exp. Sta., 96, 1934, pp. 35, bibl. 12.

These studies were undertaken to determine the degree of association in length and in shape, as represented by the ratio of the width to the length, of a number of organs of the cultivated cucumber. In the first two years a large number of selfed strains ranging from English forcing varieties with very long fruits to Russian types with very short, almost oval fruits were examined, and in the third year a similar study was made on an F2 population of 300 individuals. Correlation studies were made on variables which were based on the average lengths or indices of widths to lengths of each of the characters. A high degree of association was found to exist between the lengths of cotyledon, mature leaf, unfertilized ovary, mature fruit, seed, mature internode, height of plant at a given time, mature fruit stalk, and mature petiole both within each variety and within an heterogeneous group as represented by the F2 population. Shapes where correlated showed a similar association. There would appear to be at least three genes influencing this relationship. These are not specific for a given organ, but determine the growth of the plant as a whole. Two further indications are noted; first that the female parent has the greater influence on the length and shape of the seed and cotyledons, and secondly that the rate of growth may be more rapid in plants producing long organs than in types with relatively shorter organs. The author concludes that the investigation may serve to assist in the classification and identification of varieties, and that it may prove to be of value in indicating plants for selection work while still in the seedling stage.

424. MAHONEY, C. H. 635.611-2.8

Seed transmission of mosaic in inbred lines of muskmelons (*Cucumis Melo* L.).

Proc. Amer. Soc. hort. Sci. for 1934, 1935 : 32 : 477-80, bibl. 4.

Seed from the fruits of four progenies which were infected with mosaic all gave rise to infected seedlings, the amounts ranging from 8.9 to 27.1%. At the same time three selections, which showed no apparent sign of mosaic, gave rise to seedlings free from infection. These tests, together with other evidence, provide positive evidence of seed transmission of mosaic in muskmelons.

425. AINSWORTH, G. C. 635.63-2.8

Virus diseases of cucumber.

J. Minist. Agric., Lond., 1935, 42 : 338-44.

The virus diseases discussed in this paper are three mosaics, the green-mottle mosaic, the yellow mosaic, and the yellow-mottle mosaic. The latter, although not the commonest, is the most

serious, because it is known to infect many other plants including the tomato. As far as is known the first two are specific only to members of the cucumber family. Methods of transmission have not been fully elucidated, but all three are easily transferred by mechanical means. The melon aphid is known to transmit yellow-mottle mosaic, and it is suspected that there may also be other insect vectors. Therefore fumigation may prove to be indirectly beneficial. No cucumber varieties in this country are immune to mosaics, so that control measures have to be concentrated upon preventing the transmission of the disease. To quote the author, "the essential point in the control of the cucumber mosaics is to start with healthy plants, and then to ensure that viruses are not introduced from without". These conditions are most nearly fulfilled by the best nursery practices and cultural methods employed to produce a successful crop. The first step is to ensure that seed is free from infection. Yellow-mottle mosaic has been shown in America to be seed transmissible, and there is some evidence to show that the other two behave similarly. Remains of old crops should be destroyed. Weeds should all be suspect as alternative hosts and therefore destroyed. Common white bryony, *Bryonia dioica*, for example, is susceptible to yellow-mottle mosaic. Where, despite precautions, an outbreak occurs, infected plants and those adjacent should be rogued, great care being taken to avoid contaminating healthy plants by contact of hands or knives, etc.

426. CULPEPPER, C. W., AND MOON, H. H. 635.61
Composition of the developing asparagus shoot in relation to its use as a food product and as material for canning.

Tech. Bull. U.S. Dept. Agric., 462, 1935, pp. 23, bibl. 17.

Asparagus shoots at six different stages of development, namely when 4", 8", 18", 36" and 72" (twice) long were divided into sections of equal length, and the sections subjected to chemical analysis. The samples were taken over a period of about six weeks. Analyses were conducted to determine moisture contents, soluble, insoluble and total solids, reducing, non-reducing and total sugars, acid-hydrolysable polysaccharides, titratable acidity, total astringency, nitrate, amino- and total nitrogen. A second series of analyses were made concurrently to determine changes of composition of young shoots with the advance of the cutting season. For this purpose all the shoots tested were of the same length, 4 inches, with the unavoidable exception of the first lot taken, which were shorter. Finally a range of practical investigations upon canning quality and palatability together with pressure and cooking tests were undertaken. Segments representing tip, intermediate, and basal lengths were again examined, and throughout the season whole shoots 4 inches in length were canned at intervals to determine the effect of the date of cutting. Detailed results of the chemical analyses are given. Of the stalks 4, 8, 18 and 36 inches long, the authors consider that the amount of material per stalk which would make an acceptable food product seemed to be greatest in the 18 inch stalks. The effect of the time of season of cutting upon the quality of the canned or fresh cooked product was not marked in the case of 4 inch shoots, but taller stalks were much less desirable late in the season than stalks of equal height harvested earlier. The tip region was held in all cases to provide the most pleasing quality in the canned product.

427. SØRENSEN, H. 635.53
 Dyrkningsforsøg med Sorter og Stammer af Selleri. Sorts- og Stammeforsøg med Selleri. (**Tests of celery varieties.**)
Tidsskr. Planteavl., 1934, 40 : 235-52.

The yield and quality of 18 varieties have been compared at Hornum (sandy soil), Spangsbjerg (medium soil) and Blangsted (heavy soil) for 4 seasons. Considerable differences were found in yield, thus Emperor I yielded 21.6 tons* (roots) per ha. [or about 8.5 tons avoirdupois per acre.—ED.], three strains of Blangstedgaard Alabaster I 19.6-20.1 tons per ha., another Alabaster variety 15.0 and a Prager celery 13.1 tons per ha. N.E.

* i.e. tons of 1,000 kg. each.

428. I. SEVERIN, H. H. P. 632.8

Experiments with the aster-yellows virus from several states.

Hilgardia, 1934, 8 : 305-25, bibl. 21.

II. SEVERIN, H. H. P., AND HAASIS, F. A.

Transmission of California aster-yellows to potato by *Cicadula divisa*.

Ibidem, 1934, 8 : 329-35, bibl. 2.

III. SEVERIN, H. H. P.

Transmission of California aster and celery-yellows virus by three species of leafhoppers.

Ibidem, 1934, 8 : 339-61, bibl. 23.

I. In experiments from a number of States of the U.S. carrots and asters were experimentally infected both by aster-yellows and carrot-yellows viruses. *Cicadula divisa* was the vector employed. Celery proved highly resistant to strains of both viruses obtained from all states except California.

II. 50% inoculated potato plants contracted the disease, when the California strain of aster-yellows virus was used. *Cicadula divisa* was again the vector, and the incubation period varied seasonally from 20 to 63 days. The virus was not, however, recovered from potato plants, and has not been found occurring under natural conditions.

III. In addition to *Cicadula divisa* two insects found to be vectors of yellows virus under certain conditions were *Thamnotettix montanus*, and *T. geminatus*.

FLOWER GROWING.

429. NOTCUTT, R. C., AND NOTCUTT, R. F. 635.977.32

Flowering cherries.

J. roy. hort. Soc., 1935, 60 : 354-62.

The greater part of this paper is concerned with listing the principal varieties, of which there are many, and their main characteristics from an ornamental point of view. This section is, however, preceded by a few observations on the cultivation of flowering cherries in general. They will grow in a wide range of soils, though preferring a deep well-drained loam, and show considerable tolerance of acidity. In light sandy soils a strong and vigorous variety is to be preferred. Applications of lime and organic manure are often rewarded by improved growth. Planting and shaping of the trees is similar to orchard practice but trees are best put in when 3 or 4 years old. Standards make a more effective display than bush trees, especially for varieties with a weeping tendency; once established the less pruning the better. Propagation in this country is done by budding or grafting on to the wild gean, *Prunus Avium*, and recent comparisons with trees on a Japanese stock have confirmed the opinion that it is the best rootstock available.

430. BARNES, H. F. 633.812-2.6/7

Lavender pests.

J. roy. hort. Soc., 1935, 60 : 113-18.

Notes are provided on twelve species of caterpillar found on a single hedge of lavender during one year. These were the buff ermine, *Diacrisia lutea*; the garden tiger, *Arctia caja*; the lesser yellow underwing, *Triphaena comes*; the cabbage moth, *Mamestra brassicae*; the dot, *Mamestra persicariae*; the bright line brown eye, *Miselia oleracea*; the small angle shades, *Euplexia lucipara*; the gothic, *Naenia typica*; the mouse, *Amphipyra tragopogonis*; the beaded chestnut, *Amathes lychnidis*; the silver Y, *Plusia gamma*; the willow beauty, *Boarmia gemmaria* var. *perfumaria*. Each caterpillar is described briefly, and a list of alternative, cultivated host plants is appended in each case. In addition to the above list, caterpillars of the white ermine moth, *Diacrisia lubricipeda*, although not found on the lavender hedge, were successfully bred artificially upon it. The text is accompanied by clear photographs of each species in both larval and adult stages.

431. WILSON, G. F. 589.124 : 632.752

The rhododendron white fly.

J. roy. hort. Soc., 1935, 60 : 264-71.

The rhododendron white fly, *Dialeurodes chittendeni*, was first noticed in England in 1926, and its present distribution would appear to be limited to the home counties. A detailed description of the pest and its life history is given. No other host plants have been discovered, and in fact its occurrence on rhododendrons would appear to be limited to those types which possess few hairs or scales on the foliage and have a relatively thin epidermal layer. A list of resistant and susceptible varieties is appended. Owing to the danger that this pest may increase the writer advocates the use of control measures, when the following symptoms of an early infestation are observed :—The presence of mottled leaves ; the presence of pupa-cases on the leaves ; and finally blackened foliage due to sooty moulds, which develop on the honeydew produced by the insects. The most satisfactory method is to spray using the following formula : white oil emulsion 1½ pints, nicotine (96%), ¾ fluid oz., water 10 gallons. This is best applied in September or early October, but may be used as late as May, and the pressure should be at least 90 lb. per square inch. A 5% tar distillate wash used in mid-Winter may also be effective. Nicotine dust applied two or three times in early June to mid-July readily destroys adults congregating on the young foliage. Drastic pruning and destruction of infested branches may also be desirable. Young plants leaving nurseries should be disinfected by dipping them in one of the liquid insecticides mentioned above.

432. COTTIER, W. 632.753

Aphides affecting cultivated plants. (3) Aphides of the rose, chrysanthemum and *Elaeagnus*.

N.Z. J. Agric., 1935, 50 : 353-8.

The following aphides found in New Zealand are described: on roses *Capitophorus rosarum*, and *C. tetrarhodus*, *Macrosiphum rosae*, and *M. gei*; on chrysanthemums *Macrosiphoniella sanborni* and *Anuraphis helichrysti*; and on *Elaeagnus* *Capitophorus braggii*. A list of alternative host plants is appended in each case, and the article concludes with a note on control measures by the eradication of these hosts, and by spraying with nicotine sulphate and soap, and/or summer-grade white oil.

CITRUS AND SUB-TROPICALS.

433. NORO, K. 634.31

Fukuhara orange. [Japanese-English summary.]

Bull. Shizuokaken agric. Exp. Sta., 36, 1935, pp. 9.

A new navel orange now being propagated in Japan is described and illustrated in colour. It is supposed to have originated as a bud sport of a Joppa orange that had been topworked on Yuzu. It is of vigorous growth. When used as scion in topworking the shoots grow over 6 feet long, while the leaves at the base of the shoot are relatively extremely large. Neither of these characteristics is common to other oranges. The flesh is sweet and luscious and in juice is greatly superior to the ordinary Japanese navel orange. The yield is high and biennial bearing is not apparent. Trifoliate, the usual stock in Japan, appears to be not quite suitable and a more vigorous one is to be preferred.

434. HARDY, F., AND RODRIGUEZ, G. 634.323-1.4 + 631.8

Grapefruit investigations in Trinidad.

Trop. Agriculture, 1935, 12 : 205-15.

The investigations have so far been divided into three sections, (1) a study of the grapefruit soils of Trinidad, (2) the analysis of leaves from trees in a manurial experiment, and (3) the analysis of a limited number of fruits. The soil investigation revealed that on the whole most

of the soils are acidic, total nitrogen very high, available phosphates very low, and available potash variable. Calcium appears to be a specially important element for grapefruit and citrus generally, and judicious liming seems to be an important need. Nitrogen being abundant it would appear that the application of large quantities is unwarranted. The phosphate problem has not, however, been sufficiently investigated, but potash manuring seems to be necessary in most instances, although owing to its inter-relationship with the calcium content in the plant its application to lime-deficient soils may be both harmful and wasteful. The manurial plots from which the leaf analyses were made had received a general dressing of lime beforehand. They were rather below the average soils for total nitrogen and had a low C/N ratio. The authors summarize the inter-related effects of manurial treatments as follows:—(1) Nitrogen in leaf is increased by nitrogenous manure, but decreased by potash and phosphatic manure. (2) Phosphate in leaf is decreased by all treatments for reasons that are not yet clear. (3) Potash in leaf is very greatly increased by potash manure and pen manure, but decreased by nitrogenous manures, unless applied in heavy dressings, and by phosphatic manures. (4) Lime in leaf is greatly decreased by potash manure, but increased especially by nitrogenous manure and by phosphatic manure. Pen manure appears to have acted mainly as a supplier of nitrogen and particularly of potash, but an important effect seems to have been a general levelling of nutrient contents of the leaf. Growth rate measurements show this to have been beneficial. Comparisons were made in each case with the "standard" leaf analysis of similar grapefruit in California. The authors in conclusion state that "the balance of nutrients in a manure is at least as important as the total amount of manure, and a properly balanced mixture conveys the essential ingredients in smallest effective quantities and, therefore, at least relative cost". Similar leaf analyses have been carried out in different areas of Trinidad to compare with the California "standard" and the results of the soil survey. Fruit investigations have been carried out with typical grapefruits from two estates, a "lime-land" and an "acid-land" estate, four commercial grades being analysed. Quality appears to be good as indicated by relatively high juice and pulp and very high sugar-acid ratio. This ratio was higher in lime-land fruits as was lime and phosphate in rind and juice, but nitrogen and potash were relatively lower. Comparing choice-grade and culls the former had rather more sugar and acid and a higher sugar-acid ratio. High nitrogen, as commonly found in excessively wet seasons, seems to be associated with low quality.

435. HERRERO, M., AND ACERETE, A. 634.3 : 581.331.2
Morfología del polen en el género *Citrus*. (Pollen morphology in citrus.)
[English summary.]
Bol. Inst. Invest. agron. Madrid, 1935, 1 : 11-31, bibl. 5.

Investigations were made on pollen grains of *C. Aurantium* (sour orange), *C. sinensis* (sweet orange), *C. maxima* (grapefruit), *C. nobilis* Lour. (mandarin), *C. limonia* (lemon). The pollen grains of the lemon are very distinctive, being considerably larger than those of the other species examined. Although it was not possible to identify different varieties of sweet orange by their pollen grains, these would appear to form a useful auxiliary means of identification and especially classification. There are distinct indications that the pollen grain texture actually resembles that of the fruits at least in certain varieties of sweet orange. Thus in 3 investigated varieties of blood oranges in one smooth-skinned variety the exine of the pollen grains was almost smooth, in another, a rough-skinned variety, the exine of the pollen grains showed pronounced pimples, while in a third both characteristics were intermediate.

436. TERRA, G. J. A. 634.3 : 581.144.2
Abnormale verdikkingen van den wortelhals ten gevolge van verkeerd planten van djerokcs. (Abnormal thickening of the root crowns of citrus as a result of bad planting.)
Landbouw., 1934, 10 : 312-5.

Certain citrus trees budded on "Citronella" rootstocks [= rough lemon.—ED.] failed to grow with the normal vigour expected of this stock. Examination showed a swelling of the stem from ground level to 10 cm. above ground, and extending below ground into the beginnings of

the lateral roots. It was discovered that these swellings were caused by the strangulation of the main stems and some of the lateral roots by other roots having been accidentally twisted round them either when planting out or in the nursery bed. The difference in appearance between this and other causes of stem swellings, such as crown gall and incompatibility between stock and scion, are described and drawings are given of 3 typical examples.

437. WEST, E. S., AND BARNARD, C. 634.31-1.55

The alternation of heavy and light crops in the Valencia late orange.

J. Coun. sci. industr. Res. Aust., 1935, 8 : 93-100, bibl. 8.

This article reports progress in investigations at the Commonwealth Research Station, Griffith, N.S.W., as a result of which it is hoped to eliminate or reduce the habit of Valencia oranges of bearing heavy and light crops in alternate years and to cause them to bear moderate crops every year. Apart from the disorganization in marketing which this habit occasions the fruit itself is adversely affected, the oranges of the light years being large, thick-skinned and poor in juice, while those of the "on" years are undersized and of poorer quality than would be the case with moderate crops. Biennial bearing in Valencias appears to be (a) more marked in inland and irrigation than in coastal areas, (b) to be related to the strain of the variety, and (c) to start with the earliest fruit bearing of the young tree. It has not so far been possible to correlate (b) with morphological or phenological characteristics. It is noted that a tree is often even "out of step" with itself, certain branches being in their "on" year while the remainder are "off". The favourable results achieved with biennial bearing apples by blossom thinning during the "on" year suggested the line of investigation reported here. It was recognized that the times of differentiation of the flower primordia of deciduous and evergreen trees is essentially different. From studies made by the authors it was established that the terminal flower primordia of the Valencia and Washington navel orange differentiate in early spring when the young shoot is about to emerge from the protective scales, while the axillary flowers differentiate when the shoot is about $\frac{1}{4}$ in. in length. Thinning experiments, statistically analysed, with fruit in the "on" year gave the following results. Trees with no fruit removed yielded significantly less the following "off" year than trees in which (1) half the fruit was removed in May, (2) all the fruit was removed in May, (3) all the fruit was removed in August. There is no significant difference between the yields following these three treatments, but trees in which all fruit was removed in January yielded significantly more than the other treatments. Though the optimum time for thinning was not indicated, it is concluded from the data that the partial or total removal of the heavy crop up to August will increase the yield the subsequent year and that the earlier the thinning the greater the effect. Thinning in March had no effect on the size of the fruit. The effect on fruit size of still earlier thinning is being investigated. Other effects of thinning noted were an immediate revival of water starved trees following the removal of fruit during a very dry period in May and a fresher and greener appearance in September even on soil in good moisture condition of those trees whose crops had been thinned in March. The total or partial removal of a crop also led to increased vegetative growth. The recommendation is made that a January thinning of fruit during the heavy crop year might reduce the alternation between heavy and light crops of Valencia orange in the irrigation districts.

438. REED, H. S., AND FREMONT, T. 634.3 : 581.144.2

Factors that influence the formation and development of mycorrhizal associations in citrus roots.

Phytopathology, 1935, 25 : 645-7, bibl. 4.

The chemical and physical nature of the soil and the seasonal activity of the tree play a considerable part in determining the conditions for physiological equilibrium between the cells of citrus roots and their endophytic mycorrhiza. Roots of *Citrus sinensis* at Riverside Citrus Experiment Station, California, were examined. The roots were taken from plots that had received annually for the past 7 years (a) cover crops and stable manure, (b) no fertilizer, and (c) plots that had received sodium nitrate only. Roots growing under (a) conditions appeared

to develop a definite resistance to the invading fungus and it seems that an active proteolysis takes place which digests first the intracellular mycelium and then the adjacent cytoplasm of the root cell. Under (b) conditions there was little power of resistance or digestion of intracellular hyphae. The mycelium occupied mainly the intercellular spaces, sending sparingly into comparatively few cells of the cortical parenchyma hyphae differing little in histological character from the intracellular mycelium. In this case the fungus appeared to be truly parasitic, the ends of the branches being often in contact with the nuclei of the cells. Under (c), in which sodium nitrate was the only fertilizer used, the cortical cells were abnormally large and had shown an exaggerated reaction to the penetration of the endophytic fungus, which it was difficult to recognize owing to the avidity with which the granular contents of the cells absorbed stains. No mycorrhiza cells were found in which infection was followed by digestion nor any evidence of a beneficial association with the fungus. Phenolic precipitates indicating profound disturbances in metabolism were found in the root cells. The trees looked unhealthy and suffered from mottle leaf. Root infection takes place normally principally during the spring months when growth is active, and the mycorrhiza disappears when growth ceases. Endophytic fungus was found all the year round in the roots of the unfertilized trees.

439. HERRERO, M., AND ACERETE, A. 634.31-1.547.6
 Proceso de maduración de la naranja de las variedades más cultivadas de España. (**Ripening in orange varieties most commonly grown in Spain.**)
 [English summary.]
Bol. Inst. Invest. agron. Madrid, 1935, 1 : 33-47.

All trees in the experiment were worked on sour orange under approximately identical conditions of soil and climate. The density, citric acid, glucose, saccharose, total sugar and sugar:acid ratio were determined at monthly intervals from December to April in the fruits of some 10 varieties. The Mandarina común consistently had the highest sugar content and the highest sugar:acid ratio. Early maturity is clearly shown by rapid diminution of acidity and increase in proportion of sugar, e.g. Washington Navel. Colouration proceeds quickly in the early varieties from green to deep orange without any pause at the yellow. Certain varieties, however, colour thus before they are really ripe, e.g. the Torregrosa. In all the varieties examined the glucose:saccharose ratio is almost identical and remains constant throughout the whole period of ripening. Judged on their sugar:acid ratio, which corresponds with their suitability for eating, Washington Navel and Cadenera may be considered early, the Comuna and the blood oranges in general as intermediate, and Verna and Valencia Late as late varieties.

440. HAAS, A. R. C., AND KLOTZ, L. J. 634.3 : 581.192
Physiological gradients in citrus fruits.
Hilgardia, 1935, 9 : 181-217, bibl. 29.

The physical and chemical characters of citrus fruits differ according to the portions examined. This applies in particular to the calyx and styler ends. Likewise lesions due to malnutrition and to certain fungi tend to be localized at one end of the fruit or another. In the investigation described here the comprehensive analyses of different sections of a number of citrus fruits are detailed, attention being drawn especially to differences found between the two ends of the fruits. The authors hope that their results may serve as a basis for explaining the characteristic localization of certain of the lesions and other disorders mentioned above.

441. CAMERON, S. H., AND APPLEMAN, D. 634.31 : 581.192
Total nitrogen in developing flowers and young fruits of the Valencia orange.
Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 204-7, bibl. 2.

Flowers and young fruits were collected from four 12-year-old trees at weekly or bi-weekly intervals from March 6th to June 24th. Total nitrogen was determined by the Kjeldahl-Gunning method. The data collected from all four trees were practically identical. They indicate a gradual increase in both dry weight and absolute nitrogen in blossoms and young fruit during

March and April and subsequently a very rapid increase during May and June. The percentage of nitrogen to dry weight, however, showed a slight but consistent decrease during the whole period. From previous evidence* it seems that blossoming and shedding of young fruits results in an actual diminution of the nitrogen content of the tree as a whole. This is supported to some extent by a comparison of flowers which developed at different times during the blossoming period, namely March 1st, 8th and 15th. Those developing earlier were distinctly richer in nitrogen than the later flowers. Observations indicate that seasons of heavy bloom are those of heavy "June drop" and light crops, the size of the crop being inversely proportional to the amount of blossom. The authors consider that it is reasonable to suggest that the determining factor is the supply of nitrogen, and it would appear that this content in the tree is at a minimum during May.

442. MENCHIKOWSKY, F., AND PUFFELES, M. 634.323-2.191 : 581.192
The ratio of Ca, Mg : K, Na and the chlorosis of grapefruit in the Jordan Valley.
Hadar, 1935, 8 : 161-4.

Two plots of grapefruit trees, the one showing marked chlorosis and the other appearing normally healthy were selected for comparative study. Analysis of the soil and of the leaf ash failed to show any correlation between the incidence of chlorosis and the presence of excessive chlorine or the absence of iron, magnesium, or boron. The authors conclude, however, that chlorosis may be an external symptom of an unsatisfactory K_2O , Na_2O : CaO , MgO ratio, and that if this ratio is too low the tree becomes more sensitive to the toxic effects of chlorine.

443. ALLWRIGHT, W. J. 634.3-1.67
Irrigation trials.
Citrus Grower, 1935, No. 40 : 24-39.

The trials described here were undertaken to compare the effects of two methods of irrigation, the basin and the part-furrow—part-basin methods in portions of two orchards containing 14-year-old trees of Washington Navel. The soil was a deep, well-drained, red sandy loam typical of citrus orchards in the Rustenburg district. In the basin system one furrow was made down the centre of the space between the rows of trees and water was led from this to square basins, divided in the middle parallel to the furrows, each of which surrounded one tree. At 18" from the trunks circular banks were built to prevent direct contact between trunks and water. In the part-furrow—part-basin system three furrows were dug between the rows of trees, the outer two furrows supplying water to small basins constructed in the rows between each pair of trees. Diagrams accompanying the text show very clearly what was done, and also illustrate the modifications necessary when the slope of the land is too great to permit the use of large basins. The part-furrow—part-basin system had previously been used, and the construction of basins alternating with this system over 4 rows of trees in two plots in each orchard was carried out in June, 1933. Irrigating was done at intervals of three weeks, and the amount of water applied in each case did not differ materially. Wilting at mid-day was observed in the part-furrow—part-basin plots towards the end of the intervals, but not in the basin plots. The way in which each system moistened the subsoil was studied in trenches 2' 6" wide and 3' 6" deep, dug to give profiles across basins and furrows, 3 days after watering. From these it was reckoned that 95% of the soil in the basin plots was moistened to a depth of 3 feet compared with 55% in the others. Observations made with a soil tube indicated that in the part-furrow—part-basin plots very considerable variation in depths of moistening occurred, whereas in the basin plots extremes were approximately 5 feet and 30 inches. At the same time it was judged that about three-quarters of the roots of the trees were in the top 2 feet and very few deeper than 3 feet. The effects of these treatments on yields and quality were closely studied. The trees in the basin irrigated plots showed the following advantages :—higher average yield by nearly one case per

* *Ibidem*. The distribution of total nitrogen in the orange tree. *Ibidem* for 1933, 1934, 30 : 341-8. *H.A.*, 1934, 4 : 3 : 434.

tree on a crop of just over $4\frac{1}{2}$ cases per tree ; average overall percentage juice 48·24% compared with 44·25% ; acid per average fruit significantly lower ; average soluble solids to acid ratio significantly higher, although soluble solids taken alone were considered insufficiently higher to be of practical significance. Fruits from the basin irrigated plots were of finer texture, more uniform, and further advanced in external colouring, while internal differences in colour were also marked. They tended moreover to be slightly larger. The trees, 18 months after basining had distinctly denser foliage and larger leaves. The author goes on to outline further apparent advantages of basin irrigation, notably that it makes possible the control of amounts of fertilizer, manure and water going to each tree, and that the most economical use is being made of the water. Where water is scarce he suggests the use of 18" wide strips of malthoid laid in the furrows to check seepage. The construction of permanent basins rather than temporary ones seems to be more economical in this district. Where this is done all cultivations have to be done by hand. Ploughing is entirely eliminated. The basins do not interfere appreciably with fumigation, small hand dusting implements, or with harvesting. Owing to cheap labour and under the climatic conditions existing in this region the basin method is not appreciably more costly, and any increase in expense is amply compensated for in the improved returns. Finally the author adds a warning that his remarks do not necessarily apply to heavy soils where basin irrigation may lead to an increase in root rot.

444. ROUNDS, M. B.

634.3-1.67

Irrigating citrus orchards.*Calif. Citogr.*, 1935, 20 : 275, 291.

Four different methods of irrigating citrus orchards, namely, furrow irrigation, alternate irrigation, basin irrigation, and the overhead system are outlined and some advantages and disadvantages of each are mentioned.

445. ANON.

634.3-1.8

Fertilizing experiments with citrus fruits.*Qd. agric. J.*, 1935, 43 : 368.

Fertilizing experiments were laid down under the aegis of the Ministry of Agriculture in two private citrus orchards in 1933 with the object of ascertaining whether the cropping capacity of the trees could be increased by the use of artificial fertilizers. The trees were pruned and three different fertilizer mixtures were applied to different plots in the two orchards : this was followed later by a dressing of hydrated lime. Subsequent half doses of the same mixtures were applied at intervals of about 11 months and 5 months. A very big increase was shown as a result of the first year's trials particularly (200 per cent.) in the plot to which organic fertilizer in the form of dried blood and bonedust was added. The experiments are being continued. The formulae and results to date are tabulated.

446. MATTHEWS, I.

634.3-2.19

The zinc sulphate treatment for mottle leaf of citrus trees in the Sundays River Valley.*Citrus Grower*, 1935, No. 41 : 30-2.

This is a progress report on investigations in an area where mottle leaf is common. Soil applications of zinc sulphate were given to Navels and Valencias showing mottling to an extent of 50-80% of the foliage, and the trees are now practically free. Eight pounds per tree in a narrow strip 18"-24" from the trunk has been effective, but is not recommended because of bark injury and high cost. Tests in 1934 showed spraying to be as effective, not injurious, and less expensive. The recommended mixture is 10 lb. zinc sulphate (23-25% zinc), 5 lb. hydrated lime, $\frac{1}{2}$ lb. spreader to 100 gallons water. The best time of year to make the application has not yet been determined, but spraying in the autumn and early spring had been shown to give good results. The cost for materials and labour should not exceed 2d. per tree. The author anticipates that further information on the subject will be forthcoming in the near future.

447. REED, H. S., AND DUFR NOY, J. 634.31-2.19
The effects of zinc and iron salts on the cell structure of mottled orange leaves.
Hilgardia, 1935, 9 : 113-41, bibl. 20.

"Mottle-leaf" is a functional disease of certain species and varieties of the genus *Citrus*, and is characterized mainly by the absence of chlorophyll from certain areas between the veins of the leaf or in more advanced stages by dwarfing of the leaf. This paper is principally concerned with a comparative study of the cytology of healthy and diseased leaves, and with the effect of zinc and iron applied both as a spray and through the soil. The investigation revealed that mottle-leaf appears to be characterized by an alteration in the oxidation-reduction equilibrium in the leaf. For instance nitrites are shown to exist in the sap from mottled but not normal leaves, and there are indications of a reducing action at work in the palisade cells of diseased leaves. Any beneficial effects accruing from applications of iron salts were negligible, but zinc when applied either through the soil or as a spray gave striking results. There was evidence of marked cytological restoration in old, impoverished leaves when sprayed, although their histological organization was unaltered. These results were borne out by the fact that zinc accumulates in healthy buds and in the palisade cells of green leaves, and the authors consider that it is intimately concerned with the oxidation-reduction potential of the cell.

448. WEBBER, I. E., AND FAWCETT, H. S. 634.31-2.8
Comparative histology of healthy and psorosis-affected tissues of *Citrus sinensis*.
Hilgardia, 1935, 9 : 71-109, bibl. 60.

This paper is mainly concerned with a comparison of structural differences between normal and psorosis- (scaly bark) affected bark and wood tissue in the sweet orange. Some attention is also paid to normal and diseased twig and leaf tissues. Combined with this study a search for possible micro-organisms has so far failed to reveal their presence, and the recent discovery of a symptom in young leaves resembling mosaic, together with the fact that the disease may be transmitted by budding and rooted cuttings, inclines the authors to believe that the causal agent is a virus. The histological study of the stem tissues showed that the principal characteristics of the disease were abnormal browning of the contents of parenchyma cells in the cortex, abnormal periderm production subjacent to these cells, and sometimes gum formation. Externally this gives rise to small but easily visible patches of cork which become scaly and eventually flake off. In the young leaves the mosaic-like effect has been noted above, but a more obvious symptom in the mature leaf is the appearance of round or irregular discoloured and corky areas. An examination of these areas reveals abnormal darkening of the epidermal and occasionally mesophyll cells. The production of cork occurs from a phellogen formed subjacent to epidermal or mesophyll cells with darkened contents. Finally there are some indications that the development of the disease may be accelerated by environmental factors. The text is profusely illustrated with micro-photographs.

449. HAAS, A. R. C., AND QUAYLE, H. J. 634.3-2.19 : 581.192
Copper content of citrus leaves and fruit in relation to exanthema and fumigation injury.
Hilgardia, 1935, 9 : 143-77, bibl. 46.

The investigation described here may be divided into two sections. In the first analyses were made to determine copper contents of leaves and fruit of normal trees, trees showing exanthema, and trees showing injury after fumigation with HCN. As a result it was found that leaves of exanthema-affected trees show a reduced copper content, whereas citrus trees which had consistently shown fumigation damage over a number of years contained increased amounts of copper. The comparison in each case was made with nearby healthy trees unaffected by fumigation and grown as far as possible under comparable conditions. It was not, however, found possible to give any quantitative estimation of the amount of copper which a healthy leaf

or fruit should contain. Trees from different localities gave different results, and it would seem that the amount of copper required for healthy growth varies with soil and climatic conditions. Exanthema cannot therefore be forestalled, but, once it appears, can be cured by applying small amounts of copper in some form such as copper sulphate either to the soil, or, still better, as a spray like bordeaux mixture. When this is done, some time should elapse before fumigation is carried out. In the second part of the investigation confirmatory evidence was produced from trees grown in sand cultures. Lack of copper was followed by typical symptoms of exanthema.

450. WAGER, V. A., AND CROUS, P. 664.85.3 : 632.42
Bleaching citrus fruits for the removal of the sooty blotch blemish.
Citrus Grower, 1935, No. 40 : 42-6, bibl. 1.

The present article is the outcome of a number of experiments made with solutions of various strengths to determine the best method of removing unsightly sooty blotch caused by the fungus *Gloeodes pomigena* growing on the surfaces of oranges. The process recommended is to dip the fruits for a half to one minute in a solution consisting of chloride of lime and boracic acid at $\frac{1}{2}$ lb. each to a gallon of water. This solution is similar to commercial Eusol, and its action is to bleach but not remove the sooty blotch. Incidentally it kills it and other fungus spores. The container should be wooden. After treatment the fruits must be thoroughly washed, or shrinking may occur, and then stacked to dry.

451. SHELDON, H. B., AND KIRKPATRICK, A. F. 634.3-2.944
Unusual problems in pest control.
Calif. Citrogr., 1935, 20 : 270, 292.

The title of this paper is misleading. In S. California there has been a tendency to plant citrus trees in rows about $27\frac{1}{2}$ feet apart but only 12 ft. in the rows. As a result it has become difficult to use the standard single tree fumigation tents without considerable damage to the trees. An outline is given in this paper of preliminary trials with covers 110 feet long and 45 feet wide pulled over 7 trees in a row at a time. These covers are made of lighter material than the tents and can be handled by a gang of five men. It is thought that their use may substantially reduce capital expenditure on equipment and labour charges. Their sides are more or less vertical and damage to the trees appears to be markedly lessened. The dosage of HCN is applied at several points along one side of a covered row. The indication is that the distribution of gas is more uniform than in tents and this offsets any increase there may be in leakage, while for the same reason the concentration need not be so high as usual, thereby lessening the risk of gas injury to the fruits. The only scale so far treated is the black scale *Saissetia oleae*. The relationship between the effectiveness of the treatment and the stage of development of the majority of the insects at any one time is discussed. More extensive work is to be done along similar lines.

452. RUEHLE, G. D. 632.48 : 634.3
Spraying for the control of citrus scab.
Citrus Ind., 1935, 16 : 5 : 8-9, 17-18.

Trials conducted over several seasons and on various types of citrus have indicated that copper sprays consistently give better control of scab than sulphur or mercury fungicides. Of these, home-made bordeaux mixture appears to be the most reliable. Where scab is likely to be severe two applications should be made, the first at 3-3-50 just before spring growth commences and the second at $1\frac{1}{2}$ - $1\frac{1}{2}$ -50 immediately after blossom. Half per cent. oil makes a suitable spreader. The use of bordeaux, however, promotes scale infestation, and it may be necessary further to spray with an oil emulsion or three properly spaced applications of lime sulphur later in the season. Where scab is slight and scale fairly prevalent it is preferable to use lime sulphur strengthened by wettable sulphur or an organic mercury emulsion in place of bordeaux. These will check the spread of scab and destroy scale and red spider or rust mites on late fruit.

453. KUNTZ, W. A., AND RUEHLE, G. D. 632.4 : 634.3
Some field experiments for the control of melanose and stem-end rot of citrus.
Citrus Ind., 1935, 16 : 6 : 7, 22-3, 26.

In a trial in 1933 on grapefruit spraying with bordeaux mixture 1½-2-50 plus caseinate followed at fortnightly intervals by two applications of lime sulphur gave better control of melanose than did any combinations of sulphur sprays applied three times. The following year the trials were extended to include other spraying materials and a greater range of combinations of these. Sulphur sprays were again less effective, and the best results came from applying bordeaux, 1½-2-50 in April followed by 1% oil two months later, or by lime sulphur twice at two week intervals. Some commercial forms of copper spray were, however, just about as effective. The use of a bordeaux-oil mixture is restricted to early in the season because of the damage it may cause to young fruits, and its use, therefore, seems to be limited. Bordeaux applied during the dormant season also reduces melanose, but not sufficiently to justify its use for this purpose alone. In a final trial to include an estimate of the influence of pruning grapefruit, plots were subjected to four treatments. It was found that spraying with bordeaux followed by oil combined with pruning gave the best control of both melanose and stem-end rot, spraying alone came second, pruning alone third, and the untreated plot last. The authors consider that properly handled spraying is superior to pruning alone in controlling melanose, but that in older groves in particular either pruning or a second application of spray will often be needed as well, and in the case of the latter there is a danger of spray damage from bordeaux. The result of spraying on stem-end rot developing later in storage substantiates previous claims.

454. VOÛTE, A. D., AND ZEILINGA, A. E. 634.3-2.654.1
 Enkele opmerkingen betreffende het optreden en de bestrijding van
 djerokmijten op Java. (**Occurrence and control of citrus mites in Java.**)
 [Dutch-English summary.]
Landbouw., 1934, 10 : 292-301.

The injury to citrus fruits at Malang, Java, attributed formerly to red spider, has been found to be due to an undescribed *Eriophyes* species. The mites are abundant in both dry and wet seasons and avoid both direct sunlight and greatly reduced light, hence, when fruits are not shaded by the leaves, the mites are only found on the side away from the light. In the darkest parts of the tree the mites live on the lightest side of the fruit. Half-ripe fruits only are attacked. Complete control can be obtained by dusting the trees with sulphur every two weeks from the middle of the fourth to the end of the fifth week after fruit set.

455. SUMMERVILLE, W. A. T. 632.752 : 634.3
White louse of citrus.
Qd. agric. J., 1935, 44 : 4-8.

The white louse [Syn. snow scale.—ED.] *Chionaspis citri*, is one of the commonest insect pests on citrus in Queensland, particularly in drier areas. Young may be found at any time of the year, but their numbers in winter are greatly reduced. All aerial parts of the tree may be affected, but the largest colonies are usually concentrated on the trunk and main limbs. Affected parts are quickly weakened, and hardening and cracking of the bark is typical. Mandarins are normally less subject to severe attack than oranges or lemons. Of natural enemies a number of chalcid wasps may frequently help to check the scale by parasitism, but the most important insect in this respect is a moth, *Catoblemma dubia*, the larvae of which are predacious, and which generally occur in greatest numbers towards the end of the summer. For artificial control the three most satisfactory scaleicides are HCN fumigation, lime sulphur about 1 in 12 applied just before blossoming, and resin-caustic soda-fish oil mixture used during cooler months of the year. The general health of the tree is important, trees in poor condition being much more subject to attack.

456. ANAGNOSTOPOULOS, P. T. 633.653
The introduction of the avocado into Greece. [Greek-English summary.]
Publ. Sup. School Agric. Athens, 1935, pp. 5, bibl. 8.

Only recently has any interest been shown in avocados in Greece. Recent observations indicate that fruit grown in Greece from seed of the Northrop variety of California is superior to that of the Northrop as grown in California both in proportion of edible substance and in nitrogenous constituents. It is suggested that its cultivation should be extended in Greece in parts where lemons grow well.

457. MOTTE, J. 633.85
L'Aleurites cordata au Japon. (***Aleurites cordata*, the Japanese Wood Oil Tree, in Japan.**)
Agron. Colon., 1935, 24 : 210 : 183-93, and 211 : 7-15.

This tree, a native of Japan, is not geographically widely distributed in that country and it is difficult to distinguish original wild from planted stands, since all are now exploited and regularly cultivated. It is chiefly found in the province of Hondo growing on the lower mountain slopes where the soil is deep and humid and precipitation high. A full botanical description of the tree is given. It is said to resemble closely *A. montana*. While the tree may be considered to be definitely monoecious there is nevertheless a tendency for one or other of the sexes to predominate on certain trees, which then become easily distinguishable. A tree in which the male flowers preponderate is larger, less branched, and of quicker growth. The leaves are lobed and the flowering later. The tree with mainly female flowers is dwarfer, bushier, of relatively slow growth, and has rounder leaves. In neither case is the dioecism ever absolute. Possibly it is a varietal difference. Propagation is effected by seeds. Seed is sown either in autumn as soon as gathered in mild districts, or after stratification in spring where the climate is colder. Seeds will retain their vitality for two years. The seeds are placed in water just before planting, only those which sink being used, and from these a germination of 90%-100% is obtained. A year later the seeds are pricked out into nursery beds, the final planting being made the following spring. The original density is 800 per hectare reduced by gradual elimination of weakly, male, or otherwise imperfect trees to 200 per hectare. A method of detecting the stronger growing male trees in the seed bed is to put down straw mats at a certain depth below the soil in which the seeds are to be sown and to reject at transplanting all those whose roots have passed through the mats. Trees come into bearing when 7 to 10 years old, but the first harvest is not usually made until the 12th or 13th years. At 50 years old the trees are cut down and the wood applied to various industrial uses. The method of harvesting consists in picking up the fruits off the ground either as they fall or in two gatherings at 10 day intervals. The seeds are depulped by fermentation or if old by pounding in a mortar, usually with a straw mat at the bottom. The oil is extracted by expression after desiccation, the yield being about 1.7 litres per 10 litres of seed. Two expressions are made and their oils mixed. The mixture is clarified by settling, and is then ready for sale.

458. HORNE, W. T. 634.653-2.3/4
Avocado diseases in California.
Bull. Calif. agric. Exp. Sta., 585, 1934, pp. 72, bibl. 48.

A comprehensive review of avocado diseases in California. Each disease is described in detail, and where possible control measures are given. The profuse illustrations accompanying the text should be of considerable assistance in identification.

459. PALMER, D. 634.653-2.4
Controlling several avocado diseases.
Calavo News, May, 1935, pp. 5, 7.

The injury caused by the *Dothiorella* fungal rot is described and the results of spraying experiments are summarized. In brief it was found that the most effective formula for the control

of the rot was commercial bordeaux 16 lb., wettable sulphur 6 lb., blood albumen spreader 6 oz. to 100 galls. water. Wettable sulphur alone proved the next most effective fungicide. Applications when the fruits are fairly well developed are of greater importance than are earlier applications. Both the above formulæ will also control avocado red spider. Finally the fruit should be picked as early as possible after it has attained a satisfactory oil content. Leaf tip-burn is also mentioned, and the principal cause is held to be salinity, leading to excessive deposition of chlorides in the leaves. Where drainage is good the use of wind protection, frequent irrigations and periodic leachings, combined with adequate fertilization and including the addition of organic matter may be of considerable assistance. Finally there is a note on lime chlorosis, for which the cause is held to be excessive carbonates in the soil. Applications of sulphur or sulphate of iron may relieve this condition.

460. MCKENZIE, H. L. 634.653-2.752
The latania scale of avocados.
Calavo News, May, 1935, pp. 4, 7.

The life history of the latania scale and the damage done by it are described briefly. The chalcid, *Aphytis diaspidis*, is the only known hymenopterous parasite, whilst among predacious insects the commonest is the two-stabbed ladybird beetle, *Chilocorus bivulnerus* which feeds on the scale in both adult and larval stages. Fumigation tests with HCN showed a satisfactory kill at dosages of 18 to 24 cc. and with exception of the highest dosage (24 cc.) no tree damage occurred. An outline is given of fumigation technique with either HCN or calcium cyanide. Oil sprays have also been tried, but do not appear promising.

TROPICAL CROPS.

461. DAVIES, R. M. 633.72
Tea cultivation in the southern highlands of Tanganyika.
East African agric. J., 1935, 1 : 50-4.

An account is given of the recently established tea industry in the southern highlands of Tanganyika. The more general aspects of planting, cultivation, pruning, plucking, and manuring are described, and the successful application of sulphur to the soil to control "tea yellows" in this area is noted.

462. GADD, C. H., AND EDEN, T. 633.72-2.112
Drought conditions in relation to tea culture. I. Water and the plant.
II. The soil as a water reservoir.
Tea Quart., 1935, 8 : 20-33.

As a result of the exceptional drought conditions in 1934 the authors conducted a joint survey in a badly affected district to determine what measures, if any, might be taken to alleviate the damage which would be done if similar conditions were repeated in future seasons. Gadd concludes that reduction of leaf area by pruning or stripping when wilting is first apparent affords the best means of minimizing the effect of severe drought. Eden further considers that deep cultivation to promote deep root development would be of advantage if performed before drought conditions are definitely established, but that cultivation in the dry period should be avoided, as any check to loss from capillary action would definitely be outweighed by the increased loss from direct evaporation. Moreover, it is suggested that the air as a source of water apart from dew will only be of value to a well aerated soil. Shade trees, too, by competing with the tea plants promote deep rooting and as such their demands during drought periods cannot be considered necessarily to be directly detrimental. These papers were read at the fourth conference of the Tea Research Institute of Ceylon, and were followed by a general discussion.

463. HOWARD, A. 631.8 : 633.72

The manufacture of humus from the waste products of tea estates.

Publ. British Sci. Guild, 6 John Street, Adelphi, London, W.C.2, 1935, pp. 8.

This is a popular account of the Indore method of making compost with particular reference to tea estates. The essential processes are outlined briefly, but those who desire more detailed descriptions should refer to the book by Howard, A., and Wad, Y. D., *The Waste Products of Agriculture*, 1931, Oxford Univ. Press. (*H.A.*, 1931, 1 : 4 : 422.)

464. MOERDYK, J. L. 633.73

Coffee production in the Union.

Fmg. S. Afr., 1935, 10 : 239-40.

Trials were initiated to discover how the coffee plant would grow in typical soils at different altitudes in two areas, namely the Zoutpansberg, and the dry regions in northern Natal. As a result the Department considers that in the light of present experience coffee production on a commercial scale is too risky an undertaking to be recommended. The principal reasons for this are that *C. arabica* is subject to very severe attacks by stem-borers, for which no effective control is known whilst *robusta* trees, though unaffected by borers, are at present exceedingly difficult to transplant. Other points arising out of these trials were as follows : An outbreak of leaf disease* caused by *Hemileia vastatrix* on *arabica* was immediately stopped by treatment with bordeaux mixture. Where the annual rainfall is under 30 inches irrigation should be practised. And lastly, the provision of shade by planting *Grevillea robusta* and banana trees was superfluous under the conditions in question and even appeared to be detrimental.

465. KIRKPATRICK, T. W. 633.73 : 551.56

Studies on the ecology of coffee plantations in East Africa. I. The climate and eco-climate of coffee plantations.

Publ. East African agric. Res. Sta. Amani, 1935, pp. 66, bibl. 25, 5s.

The term "eco-climate" refers to the meteorological conditions in a habitat, and as such is hardly distinguishable from the expression "micro-climate" used by some other writers to describe a particular climate in a small place such as under a tree or in a room, etc. The investigations described here were undertaken mainly on two close-planted, unshaded coffee estates at Kiambu, Kenya Colony, and were divided into two main parts. In the first the object was to discover the relationship between the "standard" climate and the climatic and eco-climatic conditions in a coffee plantation. The standard climate was recorded in a meteorological screen of approved pattern situated in the open on the outskirts of the plantation, whilst the other recordings were made amongst the coffee bushes at about 100 yards distant. Both stations were on level ground, and the first step was to discover what instruments might be used to give reliable readings under the two sets of circumstances. For instance the use of an ordinary thermometer for recording temperature relies for accuracy upon the free passage of air through the screen. In a plantation circulation is very greatly restricted, and it was found necessary to use an Assmann psychrometer, in which a current of air is drawn by a fan over the thermometer bulbs. When the reliability of instruments had been determined, recordings were constantly kept over two periods, namely from the middle of May to the beginning of October, and from the middle of December to the end of the following March. These records included all aspects of air temperatures at all times of the day and night, attempts to determine the temperatures of the leaves and trunks of coffee bushes, and the body-temperature of an insect (*Antestia*) on the surface of a coffee bush, soil temperatures at several depths, humidity in relation to temperature under various conditions, wind, evaporation, and precipitation of moisture, and finally a broad determination of light intensities. The main general conclusion that can be drawn from these records are that under almost all circumstances the temperature and humidity in a coffee plantation show greater extremes than in the open, whilst wind velocity and the amount of daylight that penetrates are very greatly reduced. The author further concludes that the determination of meteorological conditions by standard

* This disease did not occur under dry conditions.

methods should be sufficient to allow fairly accurate deductions to be made as to conditions prevailing in a close-planted unshaded coffee plantation on level ground. In the second part of the investigation the various factors which modify the climate of a coffee plantation were studied. These include topography, spacing of the bushes, pruning, shade, windbreaks, cover crops and mulches. A table is appended in which a rough indication is given of the way in which, and the extent to which each of these factors may modify conditions found in the level, close-planted, unshaded plantation described above.

466. GILLET, S.

633.73-1.534/535

Vegetative propagation of coffee.

East African agric. J., 1935, 1 : 76-83 and *Emp. J. exp. Agric.*, 3 : 210-14.

Various methods of vegetative propagation for coffee are being tested in Kenya. Up to the present root and leaf cuttings and, with the exception of plants raised in this way by one grower, hardwood cuttings have failed to give any establishment. Standard methods of layering and marcotting proved successful, but necessitated too much labour and attention. Soft wood cuttings, however, were more satisfactory. These were 6-9 inches long with a diameter not exceeding $\frac{1}{4}$ inch, the terminal leaves being retained. Put in sand in bottom-heated frames at a temperature of 68-78° F. and with high humidity they root after 3-4 months, and after 2-3 years compare closely with seedlings of the same age. A modified method of layering accompanied by ringing is also showing considerable promise in early stages. Budding and grafting are next discussed briefly. The former has not proved very satisfactory and has been abandoned in favour of grafting, of which two methods have been tried with success. Of these inarching, however, is criticized because both stock and scion must be of seedling material. Most attention has been paid, therefore, to cleft grafting in the nursery. As a result of trials it would appear that the larger the stock and scion the easier it is to obtain success. The stock should be cut first above or across a node, and a cleft about 2 inches deep made between the buds. The scion, cut to form a wedge, is inserted. It must bear one bud, but if material is plentiful two or three are preferable. The type of binding and protection used appears to depend largely upon the climatic conditions during the season when the operation is performed. The same method is suggested for grafting on to old stocks in the field, a sucker being used for the purpose.

467. BECKLEY, V. A.

633.73 : 632.191 : 631.8

Observations on coffee in Kenya. Part I. Chlorosis and dieback in coffee.

Emp. J. exp. Agric., 1935, 3 : 203-9.

The author maintains that chlorosis followed by dieback in coffee may be attributed to two principal causes. In the one case nitrogen deficiency is held mainly responsible, and in the other carbohydrate deficiency. The early symptoms of both are similar, foliage first paling and the main veins then turning yellow. Subsequent changes are, however, distinguishable. Where nitrogen deficiency is responsible nearly mature leaves are shed and the yellow terminal leaves and growing points die, the leaves usually dropping as death occurs. Progressive dying-back of branches may follow. This frequently occurs among the middle primaries. The crop suffers severely, for although outwardly the cherries (fruits) may appear normal, inside breakdown or shrivelling starts at one end of the endosperm, and most of the beans may be lost in this way. The roots do not appear to be appreciably affected and have always been found to contain large quantities of starch as may be simply demonstrated by putting iodine on a cut. Where chlorosis is due to inadequate carbohydrate supply, dieback does not begin terminally, but usually where the green immature wood starts. The death of the apical leaves follows, but they are frequently retained for some weeks before dropping. Subsequent death of the branches is as before. The crop in this case does not suffer appreciably and even cherries on dead apical shoots will contain some residue of a bean. Lateral roots show severe dieback leaving scars on the main stock root. Tests for starch are negative. The ultimate effect of this chlorotic condition is much more severe than is that caused by nitrogen deficiency, the trees taking at least 2 years

instead of one to recover. Moreover, when nitrogen is deficient the application of a readily available nitrogenous manure will arrest breakdown of the crop and produce conditions of normality the following year. This does not apply in the case of carbohydrate deficiency, but nitrogen, if applied at setting of the fruit or when the first sign of chlorosis is evident, will encourage the formation of a larger leaf area and thereby stimulate photosynthesis and carbohydrate formation indirectly. Two other forms of chlorotic condition have been recognized, but no definite cause has yet been determined.

468. CHEESMAN, E. E.

633.74

The botanical researches on cacao.

Trop. Agriculture, Trin., 1935, 12 : 171-4.

This is a progress report upon the work now proceeding in Trinidad with a view to producing cacao trees of increased economic utility. As a first step the requirements to be looked for were analysed, and one season was occupied in determining sampling constants. Thirty pods were found to constitute an adequate sample for characterizing the fruit of one tree. A survey of a large number of plantation trees followed. From a quantitative analysis it was found that the most important variation affecting yield, apart from the number of pods borne, is the value of the individual pods, as represented by the mean weight of wet cacao per pod per tree. A selection limit was then fixed at $7\frac{1}{2}$ pods (i.e. wet cacao) to the pound. Only about 2% of the trees in Trinidad reach this standard. Quality was also considered and it was found that pods containing a heavy weight of cacao contain also larger beans than the average. Thus selection based on "pod value" as above, automatically tends to improve quality as well as yield. Conjointly with the quantitative survey trees were classified on morphological characteristics into 110 "type" classes, but no reliable guide to their performance based on this system was forthcoming. Using the standard of $7\frac{1}{2}$ pods to the pound 1,000 trees were selected, and these are now in process of reduction to 100 based on final yield over 3 years. In computing this allowance was made in each case for the size of tree. These 100 trees are scattered over a wide range of soil types and environmental conditions, and the number is intentionally high, because the final test, that of the performance of their progeny, has yet to be made. In addition, however, the selected trees are to be propagated vegetatively by several methods and subjected to a series of field trials. For this purpose both seedling and vegetatively raised rootstocks will be used. The latter are raised from semi-hardwood cuttings, and owing to improvement in technique the production of sufficient stocks for field trials is now entirely feasible. The question of fruit setting and development as governed by self compatibility or incompatibility is also being studied, and a field experiment has been laid down to investigate the effects of mineral nutrition upon this aspect of the problem of cacao yields.

469. HARDY, F.

633.74-1.4

The chemical and ecological researches on cacao.

Trop. Agriculture, Trin., 1935, 12 : 175-8.

This paper embodies a brief survey of the comprehensive work in progress on the chemical and ecological aspects of cacao growing in Trinidad and to some extent in Tobago and Grenada. Environmental studies based on a comparison of "good" and "bad" cacao plots over 3 years demonstrated the marked effect of fluctuations in atmospheric moisture, and the indications were that the use of shade trees and windbreaks reduced this fluctuation to give the most satisfactory environment for cacao. In the course of a soil survey some 178 sites have been investigated, samples being taken at about 10 different levels to a depth of 6 feet. Correlations were then obtained between the chemical and physical analysis of these samples and the behaviour of cacao trees in the vicinity of the various sites. In brief the following factors were found to be of importance :—(1) The optimum soil reaction is slightly on the acid side of neutrality. A highly acid reaction in heavy soils is deleterious. (2) Optimum texture conditions vary with climatic and environmental factors. A primary requirement is even moisture status. (3) The content of free lime does not appear to influence fertility appreciably.

(4) High yields in cacao are generally correlated with a high organic content in the soil, and likewise with a high carbon/nitrogen ratio. (5) A high content of gypsum (soluble calcium sulphate) in the sub-soil appears to be definitely harmful to growth and cropping. (6) Total nitrogen, found to be high in almost all cases, appears to play little part in differentiating between low and high yielding soils in Trinidad. (7) Deficiency in available phosphates is correlated in nearly all cases with poor yields. (8) Adequate supplies of available soil potash are likewise essential, but deficiencies are less marked in Trinidad soils. Arising out of the soil survey a number of manurial trials have been started, and striking results have been obtained with artificial fertilizers, particularly with phosphates, and on some soils with potash. Simultaneously a test with tomatoes has been evolved, whereby a grower by growing this plant will be able to find without chemical tests whether his soil is phosphate deficient or not. A further line of approach has been the chemical analysis of cacao leaf tissue, which has been found to offer a reliable guide to manurial requirements. Finally, pure sand and water cultures have been used to determine if symptoms of nutrient deficiency are easily recognizable. This has been found to be the case where nitrogen or potassium are deficient. In the stage to which the study has now been developed it is possible to state with some degree of certainty whether a particular soil or a particular locality is suitable for successful cacao production. Likewise manurial trials have been shown to be well worth while. In future investigations the field trial will take prior place, and quantitative evidence will be collected concerning the practical utility of a particular treatment, and in addition further correlations between chemical characters of the soil and plant, and the yield and quality of the cacao produced.

470. POUND, F. J.

633.74-1.541.5

Notes on the budding of cacao.

Fourth Annu. Rep. on Cacao Research for 1934, I.C.T.A. Trinidad, 1935, pp. 3-7, bibl. 4.

Two methods are generally used, namely fan buds on small 1-year-old or even younger seedling stocks and chupon buds on large stocks. Stocks for fan buds may be in pots or nursery beds, but the most vigorous plants are undoubtedly produced from the beds. Budding is by the rectangular patch method which is described. The top and bottom of the patch must fit closely into the prepared place on the stock but rather more latitude may be allowed at the sides. In binding $\frac{1}{4}$ inch waxed tape is used, the eye is left uncovered but the remainder of the bud must be so bound as to be water tight. No better or cheaper method of making waxed tape has been found than that of dipping plain cotton tape into hot beeswax to which a little antiseptic such as creosote has been added. The tape is cut into ten inch lengths and stored. Before use it is run rapidly through the fingers once or twice to render it adhesive. This tape can be used a second time. The stock in the bedded plants is topped back as soon as the bud begins to sprout. In pots the topping stage is omitted and the stock is cut right back when the bud has made some inches of growth. Buds that fail to sprout can often be made to do so without risk if the patch has united well by cutting them back hard. Stock selection is in its infancy, therefore seedlings from any hardy heavy bearing tree should be used. It has been found that pot grown stocks showing leaf edge browning give a high percentage of failures and stocks grown under heavy shade are less successful than lightly shaded ones. The addition of small quantities of complete fertilizer 1 month before budding to pot stock plants growing in fairly rich compost was of no advantage. Stocks which have failed should be given a comparatively long rest before rebudding. The best buds are those whose subtending leaf has fallen. These buds are not always obtainable in quantity. Less mature buds can be brought into proper condition by the removal of the leaf by a cut through the petiole about 10 days before they are required. Older budwood may be used but has the disadvantages, that the bud may be long in sprouting and that the weakly parasitic fungi on the outer layers of bark may enter the wound at budding and cause breakdown of the bud patch tissues. Budwood should be used as soon as possible after cutting, since loss of viability occurs even after 36 hours. This can be reduced by damping the bud sticks and wrapping them in plantain leaves. Wrapping in wet sterilized moss did not help at all. The

importance of discovering a method by which budwood can be kept for longer periods is mentioned. It is evident that both physiological and genetic incompatibility are not uncommon between stock and scion. Chupon buds worked on large stocks of an inch or so in diameter grow very rapidly and produce trees with a habit closely resembling that of seedlings. If budding large stocks at stake with chupon buds is to be done on a large scale, a special budwood nursery will have to be maintained in which the budlings must be kept stooled back to induce the formation of a regular supply of chupons. Trees from chupon buds can also be produced on small stocks, provided a supply of small hard chupons can be provided. Suggestions for doing this are as follows:—Stools to produce them can be established (a) from chupons rooted as cuttings, (b) from fan budlings cut back hard, (c) by inserting fan buds on the summit of the arc of a stock, which has been bent over and permanently fastened down. In recent experiments many of these fan buds grew into chupon shoots. Once established the diameter of the chupon budwood can be regulated by the amount of pruning.

471. POUND, F. J. 633.74-1.52
Certain barren types of cacao.
Fourth Annu. Rep. on Cacao Research for 1934, I.C.T.A. Trinidad, 1935,
 pp. 11-5.

Types of barren cacao trees are described. (I) *The incompatible tree.* These are trees which are apparently self-sterile; they set very little fruit but flower profusely. Their pollen will often not cause setting on adjoining self-compatible trees, although it may be viable when tested on a five per cent. sucrose medium. Trees are often self-incompatible from birth but it is also clear that this sterility comes on with age. Trees thus affected can often be rejuvenated by hard pruning. (II) *The sterile tree.* These types set fruit in abundance, but the ovules are usually absent or present in small numbers only and are often massed at the base of the ovary. Development of the stamens is normal until the stage of pollen mother cells is reached, when in place of pollen grains a mass of brownish cells is formed. These young pods ripen when about $\frac{3}{4}$ of an inch or less in diameter. The size to which they grow appears to depend on the genetic constitution of the tree, but they never contain seeds. Illustrations are given of the floral morphology of some of these types. (III) *The small podded tree.* In this type heavy crops are produced but the breakdown of parenchymatous tissue, by which is formed the mucilaginous tissue surrounding the seeds, does not occur. The beans are small and dry, fail to separate from each other and from the pod walls and are often non-viable. The increased number of pods is no advantage for the small beans require 1,000 to the pound instead of 400, and a greater number of pods has to be picked and broken while the resulting product is inferior. As pollen parents their influence can only be harmful. All these barren types should be removed from the plantation.

472. POUND, F. J. 633.74 : 581.162.3
A note on a method of controlled pollination of cacao.
Fourth Annu. Rep. on Cacao Research for 1934, I.C.T.A. Trinidad, 1935,
 pp. 15-6.

The method consists of covering the flower to be isolated with a glass tube 1 inch in diameter, the upper end of which is closed by a piece of fine gauze. The tube is fixed on the branch by means of a ring of plasticine placed round the flower cushion into which the open end of the tube is pressed. This adhesive is insect proof and far superior to tape. Mature buds are covered in the afternoon and pollinated the following morning. Four or five anthers are applied to the stigma until it can be seen with the naked eye that sufficient pollen has been transferred. The apparatus is removed 24 hours after pollination, actual fertilization having been shown to take place within a few hours. Natural set within the tubes without the intervention of insects was not observed. A brief review of pollination studies is given to show that isolation of flowers is necessary only in critical experimental circumstances and not for commercial purposes or fruit setting studies.

473. POUND, F. J. 633.74 : 581.162.3 + 631.8
Studies of fruitfulness in cacao.* V. Conditional self-compatibility and its implications.
Fourth Annu. Rep. on Cacao Research for 1934, I.C.T.A. Trinidad, 1935, pp. 17-9.
 POUND, F. J., AND DE VERTEUIL, J. 633.74-1.8
VI. First year observation in an experiment designed to test the gross effects of applications of nitrogen, potassium and phosphorus on the cacao tree.
Ibid., pp. 19-25, bibl. 1.
 POUND, F. J. 633.74 : 581.162.3
VII. Ovule loss at fertilization.
Ibid., pp. 26-32.

V. In previous papers of this series it was shown :—That the value of self pollen in setting may vary from clone to clone under similar environmental conditions. That self-compatibility and self-incompatibility became apparent on numbers of young seedling trees of uniform age and environment over a period from May to October, and that, while pollen from a self-compatible tree would set on any stigma, pollen from a self-incompatible tree would only cause setting on a self-compatible tree. It was, therefore, assumed that there is some genetic foundation for the ability to set as in the case of deciduous fruit trees in temperate countries. The fact, however, that among self-compatible trees some bore early and some late and that trees classed as incompatible often produced a fair set in spite of the obvious inefficiency of insect pollinators still required explanation. The present paper records the study of these phenomena, as a result of which it has now been established that a state of conditional self-compatibility can exist and that this condition is brought about by physiological factors which probably include mineral nutrition. This does not rule out the probability that certain trees are genetically more constantly self-compatible than others, but it does lead to a doubt as to the existence of trees genetically permanently self-incompatible. Conclusions reached on the subject of fruit setting of cacao will also be modified, as for instance that the incidence of setting of self-incompatible trees when it occurs is due to an increase of efficient cross pollinating agents in the plantation. In reality it is probably due to the change over of the tree from a state of self-incompatibility to the reverse. Thus self-pollination is, it seems, responsible for the bulk of the cacao crop. The problem viewed in the light of these discoveries will be not so much to increase the yield by an intensity of setting within limited periods as to prolong the tree's periods of self-compatibility. VI. The details and layout of this experiment are recorded in the 3rd Annual Report (brief notice in *H.A.*, 1934, 4 : 3 : 460). The 4 × 4 latin square method of layout used upon the usual run of established cacao of uniform age can demonstrate increases in yield of about 30%. Variations in the material and those due to soil heterogeneity are always high, but the precision may be increased fourfold by the use of previous records of a year in which the yields are highly and positively correlated with those of the experimental year. The following results appear from the first year's data. Potash improves bearing especially in the presence of phosphates, and possibly improves bean weight. No effect of manures on bean numbers was traced. The indications that potash applied without phosphate reduced the incidence of disease must in view of the absence of previous records be accepted with reserve. The possibility of susceptibility being a genetic factor cannot be ruled out. In the case of setting phosphate was beneficial; potash effect was obscured by the depressing effect of the nitrogen used with it; nitrogen alone increased setting of self-compatible trees. The effect of manures on the wilting of cherelles (immature fruits) is undecided. VII. An inconstant number of ovules in a pod fail to develop into beans. This loss can be detected by dissection within a week of pollination. Thirty ovaries were obtained from each controlled pollination between a number of trees. These were dissected, and counts were made of the numbers per loculus of sound ovules and failures. In all 47 samples of 30 ovaries were taken. Percentage losses in all crosses were tabulated, with incompatible matings indicated. When the pollinations

* Previous studies appeared in the 1st, 2nd and 3rd Reports and are abstracted *H.A.*, 1933, 3 : 3 : 398, and *Ibid.*, 1934, 4 : 3 : 460.

were made it was not always possible to use constant proportions of trunk and branch flowers, and therefore it was not known how far samples of 30 ovaries were strictly comparable. Eleven samples from one tree were dissected, but it was shown that the differences between samples had little influence on the results. Discontinuity in distribution may be accounted for by abnormal losses due to inadequate pollination or physiological factors. In order to compare the distributions with the Poisson series these abnormal ovaries were discarded. Testing for goodness and fit for the three types of distributions, then discovered, showed that these do not differ significantly from the Poisson series. Therefore, losses are of two kinds, one relatively constant and possibly due to the operation of lethal genetic factors, and the other irregular, and probably physical or physiological in origin. Losses from embryo abortion were not examined.

474. PYKE, E. E. 633.74-1.563
On the germination of cacao beans with special reference to storage and transport problems.
Fourth Annu. Rep. on Cacao Research for 1934, I.C.T.A. Trinidad, 1935,
 pp. 33-40.

The object of the investigation was to find means whereby cacao beans required for sowing could be made to retain their viability in the pod in tropical temperatures longer than the five to eight weeks which appears to be the present limit. The causes of deterioration are due to desiccation, fungal decay, senescence which is generally marked by the spontaneous germination of the beans in the pod, and in cases of low temperature storage to chilling. Experimental results to date are as follows:—(1) *Laboratory storage of untreated pods.* The pods were stored on the laboratory bench at an average temperature of 80° F. Effective germination after 14 days was 95%. (2) *Effect of low temperature storage on germination.* Temperatures of 50° F. and 45° F. completely destroyed viability even after 2 days. A temperature of 60° F. retained the pods in freshness and gave beans of normal germination percentage even after 20 days. Temperatures of 80° F. and 70° F. were less successful than 60° F. This result seems worthy of note. (3) *Effect of the medium upon germination.* Calcareous washed beach sand of fairly coarse texture proved to give the best germination compared with other media and was used exclusively in all subsequent trials. (4) *Effect of temperature upon germination.* Temperatures of 70° F., 79° F. and 86° F. had all produced normal, effective germination at 26-31 days. At 70° F. germination was slower in starting. (5) *Effect on germination of soaking cacao beans before sowing.* Fresh beans water-soaked for one hour at 80° F., 95° F. and 104° F. gave earlier germination but little increase in percentage over unsoaked in the final results. With beans stored for 22 days before soaking for 1 hour the final results (11%) were greatly inferior to that of the controls (30%), but by overnight soaking at laboratory temperature a final germination of 62% was obtained with these stored beans. The germination of soaked beans from infected pods was unaffected by this treatment. From this trial, however, the importance to the viability of the bean of preserving the pod wall from fungal infection became very evident. (6) *Experiments using stored pods with antiseptic and anti-desiccation treatments.* From these experiments it appears that the keeping powers of the beans with the resultant viability of the seeds depends primarily on the absence of latent or dormant infections in the pod walls, and that treatment by antiseptic is not effective, if disease is already present, unless the temperature is maintained at 60° F. Sound pods, however, may be preserved and will give good germination at temperatures between 70°-80° F. for 40-50 days provided aseptic and anti-desiccation treatment is given, an effective method being to smear the pods with vaseline. (7) *Experimental results at 53° F.* This temperature was chosen because it is that used in banana transport from South and Central America. Thus if beans would stand this temperature for 20 days they could be successfully transported from these countries, an important factor in the collection of new varieties. A low but still useful germination was obtained and viability was increased by a delay up to one week between picking and cool storing. Fungal decay is much slowed down, a factor of value if blemished pods are used. Beans removed from the pods and cool stored suffered from chilling to a greater degree than those left in the pod.

475. PYKE, E. E. 633.74 : 581.144.2
Mycorrhiza in cacao.
Fourth Annu. Rep. on Cacao Research for 1934, I.C.T.A. Trinidad, 1935,
 pp. 41-8.

An infection having definite symptoms of endotrophic mycorrhiza was regularly found in roots of cacao trees growing in a number of localities in Trinidad. In all roots examined mycorrhizal hyphae were confined to the cortex, and the meristematic regions of terminal and lateral growing points were not penetrated. The possibility that mycorrhiza may be a biotic factor influencing the mineral nutrition of the cacao tree is noted.

476. HARDY, F., AND OTHERS. 633.74-1.4
Cacao soil surveys.
Fourth Annu. Rep. on Cacao Research for 1934, I.C.T.A. Trinidad, 1935,
 pp. 51-3, bibl. 5.

A study made of two distinctive soil types occurring in the Rio Claro District, S. Trinidad, in order to gain additional information regarding the specific soil relationships of cacao.

477. McDONALD, J. A. 633.74-1.8
Manurial experiments on cacao for 1934.
Fourth Annu. Rep. on Cacao Research for 1934, I.C.T.A. Trinidad, 1935,
 pp. 54-63.

Field manurial experiments for cacao to test the specific value of phosphatic manure on growth and yield of cacao were laid down in 1932. Six separate experiments on different soil types in Trinidad were used, the layout being of the latin square type. The conclusions reached are statistically significant with a minimum probability of 20-1. It was found that the yield of mature cacao trees could be increased from 30-100% on many different types of soil by the use of phosphatic manures alone. The response of the tree varies according to soil type. On sandy or clay soils with a faintly acidic or neutral reaction the optimum application of superphosphate is 2 lb. per tree, or 600 lb. per acre. On acidic clay 3 lb. of superphosphate per tree gave additional yield. On gypseous clay soils, having a high content of calcium sulphate in the subsoil layers no benefit was obtained even though the soil was deficient in available phosphate. Possibly the effect of calcium sulphate in the soil may be to prevent the utilization of phosphate by the tree, which would account for the known association of such soils with poor growth of cacao. Since ordinary superphosphate contains over 50% of calcium sulphate, and since adequate supplies of phosphate are necessary for the cacao tree, the suggestion that the use of superphosphate over long periods of years might eventually give rise to harmful accumulations of gypsum in the soil is of great importance. Experiments have, therefore, been laid down to compare the value of ordinary superphosphate with other types of phosphatic manure, and the effect of heavy dressings of calcium sulphate on yield and on the utilization of phosphate and uptake of iron by the cacao tree.

478. McDONALD, J. A. 633.74-1.87
Mulching experiments on cacao.
Fourth Annu. Rep. on Cacao Research for 1934, I.C.T.A. Trinidad, 1935,
 pp. 64-74, bibl. 16.

The effects of mulch on the moisture content, temperature and nitrogen status have been studied on two contrasted soil types, namely a fairly heavy textured clay and a light sandy loam which is mixed with coarse gravel below a depth of 2 feet. Environmental conditions consist of high rainfall, humidity and temperature, low evaporation and light intensity. The heavily shaded ground under the trees is covered by a surface litter consisting of dead leaves and the remains of weeds cut and left on the ground in the course of routine estate practice. The mulch consisted of mixed vegetation, chiefly grasses, obtained near the experiment plots. The fresh mulch, though differing somewhat in composition on the two sites, had a relatively very low nitrogen content and a wide C/N ratio. (1) *The effect of mulch on production of available nitrogen.* A large increase in the production of soil nitrate occurred after 6 weeks and was maintained after

a second application of fresh mulch. The increased nitrate supply was accompanied by an increased production of ammonia, but the rate of nitrification greatly exceeded that of ammonia production. (2) *Effect of mulch on soil moisture.* On the sandy soil there was a greatly increased soil moisture content on the mulched plots down to 2 feet, the increase being much greater in the first 6 inch layer. On the clay soil the increase though significant was small at 6 inches, and below that depth was not significant. The reason for this difference is not clear. (3) *Relationship between soil moisture and nitrate production.* On the sandy soil there was no correlation between moisture content and nitrate content of fresh soil, in fact increased moisture is accompanied by decreased nitrates possibly on account of rapid leaching during wet weather. There is, however, a positive correlation between the rate of nitrification and soil moisture content, but not the rate of ammonia production. On the clay soils there is positive correlation between the nitrate and soil moisture content of the control plots but not of the mulched plots. This is at present unexplained, for leaching is definitely less rapid on the clay plots. In both mulched and unmulched plots there is definite correlation between the rate of nitrification, but not of ammonia production and soil moisture content. (4) *Effect of mulch on soil temperature.* The application of mulch has a stabilizing effect on soil temperature, but the differences between mulched and unmulched plots are too small for differences in yield and growth of cacao or micro-organic activity to be attributed to them. The shaded condition of the soil should be remembered which renders fluctuations in temperature normally very small. The stabilizing effects, however, of mulch on soils exposed to greater fluctuations of temperature than occur under the shaded cacao grove conditions obtaining in Trinidad cacao groves is well established.

479. McDONALD, J. A., AND RODRIGUEZ, G. 633.74-1.8 : 581.192
The effect of manurial treatments on the chemical composition of cacao leaves : the diagnosis of soil and crop nutrient requirements by means of leaf analysis.*
Fourth Annu. Rep. on Cacao Research for 1934, I.C.T.A. Trinidad, 1935, pp. 75-82.

Leaf samples taken from plots forming part of a manurial trial to which nitrogen, phosphates, potash both alone and in combination have been applied for two years were analysed. The method of sampling is shown to be adequate to produce a true representation of the groups from which the leaves are taken. From a detailed statistical analysis the following results were obtained. The association of high yield with high potash content relative to nitrogen and phosphate, and low phosphate content of leaf relative to nitrogen and potash was established. A standard leaf composition indicating a balanced nutrient supply capable of producing a maximum yield may be taken to be approximately:—total ash 9.9 per cent. of dry matter, nitrogen/potash ratio 0.89, nitrogen/phosphate ratio 4.66, potash/phosphate ratio 5.21. Leaf samples from unmanured, control plots differed widely from these values. Potash manures definitely brought the leaf nearer to the standard optimum values. Nitrogen and phosphate alone had no definite effect on leaf composition. Applied together they altered the leaf composition for the worse causing it to diverge more widely from standard optimum values and become more unbalanced than the control plots. The effects of manurial treatments on leaf composition and on yield closely agree. Cacao grown on potash-deficient and on phosphate-deficient soil shows poor growth and yield. This may result from either deficiency, the former often occurring in the plant as a result of the latter in the soil. These researches are considered to prove the value of leaf analysis in providing a more exact interpretation of the results of soil surveys and field experiments.

480. McDONALD, J. A. 633.74-1.8
Some effects of deficiencies of essential nutrient elements on the growth of young cacao plants.
Fourth Annu. Rep. on Cacao Research for 1934, I.C.T.A. Trinidad, 1935, pp. 83-5.

The effects of deficiencies of nitrogen, potassium and phosphorus on cacao plants growing in sand cultures are discussed. *Nitrogen deficiency* in young cacao plants produces stunted growth,

* Preliminary study 3rd Ann. Rep., pp. 50-62, H.A., 1934, 4 : 3 : 465.

with leaves small, few and yellowish-green in colour, occurring only near the growing points at the stem ends. The root system is stunted, but coarse and fine roots are developed in normal proportions. *Potassium deficiency* is shown by marginal browning of the leaves beginning near the tip, spreading later upwards along the edges and inwards between the veins. Height is normal, but the stem diameter is relatively small so that the trees appear spindly. Root development is normal with a larger proportional development of fine roots. *Phosphate deficiency* was not so easily apparent to the eye. The height and size of leaves of the plants were slightly subnormal but stem diameter and number of leaves were normal. Root development was normal with a smaller proportional development of young roots. A result of practical utility arising from these experiments is that it may now be possible to diagnose deficiency of nitrogen and of potassium from the appearance of the tree.

481. McDONALD, J. A. 633.74-1.85

Phosphate fixation in soils in relation to iron availability, and its possible connection with the gypsum phosphate problem in cacao soils.

Fourth Annu. Rep. on Cacao Research for 1934, I.C.T.A. Trinidad, 1935, pp. 86-7, bibl. 2.

Gypseous clay soils in Trinidad whilst possessing a high content of available calcium often exhibit a markedly acidic reaction. Under such conditions added phosphate should be fixed in an easily soluble form, readily available to the plant. Some such cacao soils already possess large amounts of available phosphates but normally produce poor crops, and in others, in which phosphates are low, the addition of phosphatic manures likewise produces no response. On the other hand fertile cacao soils also usually possess a high calcium status associated with an abundant available soil phosphate. The investigation which is described here is still in the preliminary stages, but there is some evidence to support a theory that the reason why a soil containing a high gypsum content should behave differently from a soil containing high lime in relation to phosphate is that in the former phosphate is fixed in a manner which depresses the availability of iron. A high gypsum content implies that sulphate as well as calcium is present in quantity, and it is suggested that this high concentration of sulphate may cause a lowered availability of iron in the presence of phosphate. This hypothesis is borne out to some extent by the analyses of leaf samples taken from cacao trees in a manurial experiment. The addition of phosphate alone in no way depressed the iron content in the leaf, but, when potash and nitrogen, in the forms of sulphate of potash and sulphate of ammonia were also added, a marked decrease in the iron content of the leaf was noted. In sand cultures, too, chlorosis and stunted growth were observed in plants which had received high concentration of phosphates in the culture solution, and these became still more marked where a high concentration of sulphates was also present.

482. BOBILIOFF, W. 633.912-1.535

Stekken van *Hevea brasiliensis*. (**Propagation of *H. brasiliensis* by cuttings.**) [Dutch-short English summary.]

Meded. alg. Proefst. Avros. Rubberserie, 94, reprinted from *Arch. Rubbercult. Ned. Ind.*, 3, 1934, pp. 123-6.

Seedlings of some months old having a completely lignified internode between 2 pairs of leaves are used. A piece of wire is twisted tightly round the internodal portion just above the lower pair of leaves so as to cut into the wood. A swelling develops above the ligature. After about 3 weeks the shoot is cut off below the swelling and planted in sandy soil under glass. One half of each leaf is trimmed off. In a further 3 weeks rooting will have begun. It is claimed that plants grown by this method develop especially strong root systems.

483. KARLING, J. S. 633.93

***Couma guatemalensis* as a possible future source of chicle.**

Amer. J. Bot., 1935, 22: 580-93, bibl. 18.

Couma guatemalensis belongs to the *Apocynaceae*, occurs in Guatemala and has been subjected to tapping tests for comparison with *Achras Sapota*, the standard source of chicle for chewing

gum. The investigations are only in their early stages, but would appear to indicate that, whilst this new species grows more rapidly than *A. Sapota*, its relative rates of recovery and response to tapping are not very encouraging. It is, however, a copious yielder of latex when first tapped, and since the existing data refer only to a wild, heterogeneous population, there is a possibility that selection may be successful in evolving a commercially useful type.

484. FRANSSEN, C. J. H. 634.441-2.76
Een twietal plagen van de mangga. (**Two pests of mango.**) [Dutch-English summary.]
Landbouw., 1934, 10 : 281-91.

The pests are the mauve mango borer, *Philotherctis eutraphera* Meyr., and the mango twig weevil *Cryptorhynchus goniocnemis* Margh. The first mentioned species is a small moth whose larvae bore into the young fruit causing them to drop. The control advised against this is to enclose the young fruits in muslin bags. The larvae of the mango twig weevil bore down into the twigs causing a heavy callus to develop on the edges of the wounds. Very often the twigs die. Spraying with a 1% suspension of lead arsenate is suggested.

485. VOÛTE, A. D. 634.441-2.78
Twee beschadigers van jonge mangga-loten. (**Two pests of young mango shoots (in Java).**) [Dutch-English summary.]
Landbouw., 1934, 10 : 255-71, bibl. 7.

The pests described are a noctuid, *Chlumetia transversa* Wlk., whose caterpillars bore into the tops of young shoots causing them to die off, and a moth, *Bombotelia jacosatrix* Gn., whose larvae eat only the youngest leaves of mango. Spraying with a 1% arsenate of lead at weekly intervals has effected control.

486. BELGRAVE, W. N. C. 634.6-1.8
Manurial experiments on oil palms.
Malay. agric. J., 1935, 23 : 321-35.

This article brings up to date information already recorded of the progress of manurial experiments on oil palms at the Central Experiment Station, Serdang, and on two estates. Phosphatic manuring should be remunerative when yields of oil are less than approximately 1,500 lb. per annum with trees 8 years old on normal soils of the inland type in Malaya. Rock phosphate and basic slag are equally good for the purpose. The addition of nitrogen and potash at present appears to be unnecessary. It is unprofitable to try to increase by manuring low yields which are due to unsuitable soil conditions. Preliminary recording is found to be essential for the correct interpretation of results. In the case of manurial trials with the oil palm these need only begin 6 months before the experiment starts.

487. LEVER, R. J. A. W. 632.75 : 634.61
The green coconut bug, *Amblypelta cocophaga*.
Brit. Solomon Is. agric. Gaz., 1935, 3 : 2 : 6-7.

This insect is a newly recorded species of *Coreidae* and has been found to cause some immature nutfall in the Solomon Islands. It would seem to be present in some stage on an average of about 8% of the coconut trees, but plantations showing up to 75% infestation at one time have been noted. Its most usual food plant is *Macaranga tanarius*, and from eggs laid on this plant the egg-parasite *Anastatus axiagasti* has been bred. *A. cocophaga* is the subject of further investigations at the present time.

488. MULLER, H. R. A. 634.61-2.4 + 2.1
Verwelkingsziekten van klapper. (**Wilt diseases of coconuts.**) [Dutch-English summary.]
Landbouw., 1934, 10 : 302-11, bibl. 2.

I. *Root rot of coconut palms.* An investigation into the cause of death of 30,000 coconut palms in Dutch Borneo showed that, while decline originated with root rot due to bad drainage con-

ditions, the remaining roots were invaded by the fungus *Ganoderma lucidum* (*Fomes lucidus*) as a result of which the trees died. The opinion expressed by Park in Ceylon (Investigations of root diseases of coconuts. *Trop. Agriculturist*, 1928, 70:402-7), that *G. lucidum* only becomes parasitic on coconut trees which have been damaged by some other agent, was confirmed, as was also the statement that rapid wilting of the leaves only occurs if the fungus has invaded the basal parts of the stem. II. *Drought effects on coconuts*. The symptoms were very similar to those produced by root rot. The leaves, with the exception of 2-4 of the youngest, turned brown and dropped. The roots, however, remained sound. These symptoms occurred where the underlying coral rock was covered by only a thin layer of soil. On soil which had a more pervious subsoil the trees were able to obtain sufficient moisture to avoid injury. Wilting ceased with the beginning of the rains and the damaged trees started new growth.

489. NIXON, R. W.

634.62 : 575.18

Metaxenia in dates.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, 32 : 221-6, bibl. 10.

Two pollinators, Mosque and Fard No. 4, representing the upper and lower limits of metaxenial effects produced by date seedling males in earlier experiments, were tested on the Deglet Noor variety for three seasons with similar results. Although the direct effect of pollen upon the seed (xenia) was more pronounced than on the fruit (metaxenia), differences found in the following measurements were all significant in favour of Mosque pollen; number of dates ripe and partly ripe at one observation, length of dates, breadth of dates, length of seeds, breadth of seeds, weight of the flesh of 10 dates, and weight of 10 seeds. The author is careful to point out, however, that in practice the size of the crop is commonly controlled by bunch thinning. Apart from considerations of quality, therefore, the use of a pollinator giving more and bigger fruits need not necessarily be an advantage. The possibility of being able to control the time of ripening is likely to be of greater importance. In an experiment in 1930, 5 Deglet Noor palms were pollinated with Fard No. 4 and another comparable Fard pollen, and 5 others with Mosque pollen. The first bunches from the former ripened some 15 days earlier than the Mosque pollinated dates, and this difference tended to increase later on. Similar results were obtained from a smaller trial when Mosque was replaced as a pollinator by Cook's No. 1. The author concludes with a short account of how metaxenia has been turned to good account commercially for probably the first time in connection with dates, on a ranch which had been much troubled with delayed ripening.

490. HAAS, A. R. C., AND BLISS, D. E.

634.62-2.181.2 : 581.192

Growth and composition of Deglet Noor dates in relation to water injury.

Hilgardia, 1935, 9 : 295-344, bibl. 21.

The writers distinguish only two types of injury due to water lying on the surface of developing dates, namely "checking", small lineal skin ruptures, occurring in the Deglet Noor variety near the apex, and "tearing", severe, often irregular splitting of the skin. The former occurs largely in the late green or khalal stages. After this stage the factors tending to reduce checking were principally a decrease in average length, diameter and weight per fruit accompanied by progressive shrinking of the pulp and a lessening of epidermal tension beginning at the tip end. The use of bags to protect bunches from rain tended if anything to increase checking in all cases. The more severely checked fruits may often become dark in colour, starting at the tip, and producing a state known as blacknose. The same condition may, however, occur as a result of scratching the surface of a fruit, and thus blacknose need not necessarily be a symptom of water injury. Tearing is not dependent upon either checking or blacknose, and occurs during the late khalal and rutab stages when osmotic pressures are very high. It takes the form of violent ruptures in the unripe, turgid, basal portion, where the epidermis is unable to accommodate further increases in volume. Bagging to reduce moistening by rain definitely reduced tearing.

491. DOWSON, V. H. W. 634.62.2.951
Notes on insecticide trials with date palms. Kut As-Sayyid estate 1934.
Hadar, 1935, 8 : 174-5.

Twenty-nine sprays and dusts were tested to ascertain their effect in controlling the date mite, *Oligonychus* spp., the lesser date moth, *Batrachedra amydraula*, the greater date moth, *Arenipyses sabella*. Of these insecticides only sulphur appears to give much promise of controlling the mite and of twelve types tested only two produced eradication in one application. No treatment afforded complete control of the lesser date moth, although one petroleum emulsion came near to doing so. The greater date moth on the other hand was successfully treated by certain concentrations of petroleum emulsion and a combination of caustic soda and kerosene.

492. SEIN, F. 634.771-2.76
Paring and heat sterilization of the corms to eliminate the banana root weevil, *Cosmopolites sordidus* Germar.
J. Agric. Univ. Puerto Rico, 1934, 18 : 411-16, bibl. 2.

Total immersion of corms in water with or without arsenicals, fumigation with carbon bisulphide, partial immersion in cold water for three weeks, and immersion in boiling water for one minute have been tested and found unreliable or unpractical for controlling the weevil. Paring the suckers, unless done sufficiently heavily, may be put into the same category. Investigations have shown, however, that if an inch or more of all the external surface is cut away, and the external leaf-sheathes of the stem are also removed, all or practically all of the eggs and newly hatched larvae will be eliminated. Furthermore, by paring, the tunnels of larger larvae will be exposed, and these corms should be destroyed. Suckers should of course be selected from healthy plants, and once taken from the stools, especially if pared the same day, should be removed before nightfall to prevent re-infection by weevils. Corms will germinate well even when very severely pared, but the method is better adapted to plantains than bananas, though effective for both. Planting should be done as far as possible on clean land such as has not contained any bananas for at least one year, and new plantations are best put at some distance from old ones. Where infection occurs, the removal of attacked plants, and the use of traps consisting of slices of pseudostem are advocated. In addition to paring there is another method of treating suckers which has shown promise and is receiving consideration. This is the sterilizing of infested suckers at 43° C. for eight hours in a circulating atmosphere saturated with moisture.

STORAGE.

493. ALLEN, F. W., AND MCKINNON, L. R. 664.85.037
Precooling investigations with deciduous fruits.
Bull. Calif. agric. Exp. Sta., 590, 1935, pp. 142, bibl. 42.

The precooling of fruit may be done either before or after loading in refrigerator cars. The majority of the tests described here were based on car cooling by one or other of two similar portable cooling units. In both fans drew air up through ice and distributed it over and through the load towards the centre of the car. A number of tests were carried out on cherries, apricots, plums, peaches and nectarines, pears, apples and grapes. In general these tests were designed to obtain data on one or more of the following points for each type of fruit :—the general efficiency of car precooling units in reducing temperatures after loading ; the influence of air velocity and of air temperature upon rate of cooling ; the time required by fruit to reach the temperature of surrounding air ; the amount of cooling possible in a car of warm fruit to which no additional ice was supplied during precooling ; the temperature rise in the top half of the load after precooling has been completed ; differences in temperatures of fruit in the centre and near the edges of packages, rates and variability of cooling in different packages, differences in rates of cooling of boxes in the top, middle and bottom stacks ; the condition of precooled and non-precooled fruit after 10 days, and the time fruit remained marketable after transit ;

cooling rates in a commercial cold store containing considerable warm fruit ; and finally rates of cooling in a small room specially designed for precooling. Specific and detailed results are given for each of these tests, and from the point of view of general experience the writers contend that the two primary factors in cooling fruit either in refrigerator cars or warehouse stores are air temperature and its velocity past and around the packages. In general a velocity of 250 feet per minute as compared with still air will reduce the time required for cooling by 30-50%. The use of air at several degrees F. below freezing point will have a similar result, and the fruit will suffer no damage if the air temperature is raised gradually to the level ultimately required. Air at 25° F. can be safely used in precooling warm, packed pears for 24 hours, while stone fruits can be precooled at 25°-26° F. for 8-10 hours, after which the temperature should be raised to about 30° F. Vinifera grapes can apparently be precooled as long as is desired at 28°. Diagrams, figures and summaries deal adequately with the results of tests on the different varieties of fruit. Not only are the immediate results of precooling carefully noted, but also the condition of the fruit concerned after rail transit for a week or more in cool storage cars. These data should be of great value.

494. CARNE, W. M., AND MARTIN, D. 634.11-2.1 : 664.85.11

Apple investigations in Tasmania. Miscellaneous notes.

J. Coun. sci. industr. Res. Aust., 1935, 8 : 71-5, bibl. 18.

A continuation of the notes appearing *Ibid.*, 1934, 7 : 203-14, *H.A.*, 1935, 5 : 1 : 44. The difficulty is mentioned of identifying non-parasitic diseases of apples referred to in the works of various writers in cases where the names used have different meanings. For instance superficial scald and deep or soft scald, two readily separable diseases when seen in commercial stores, are frequently called scald without any distinctive adjective. The authors proceed to describe (a) superficial scald, to which they suggest the term storage should be added to make impossible confusion with a discoloration of the skin which appears on mature apples that have never been in cold store ; (b) deep, soft or Jonathan scald. The authors prefer the term " deep scald ", the description " soft " not being applicable to harder varieties such as Rome Beauty, Democrat or Dunns. The possibility of the two scalds being related is discussed and dismissed. Experiments are noted in which, in addition to deep scald, a disorder arose which resembled the invasive alcoholic poisoning noted by Thomas.* The differences between storage superficial scald, deep scald and alcoholic poisoning are tabulated.

495. ANON. 664.85.11.037

Granny Smith apples in cold storage.

Fruit World, Melbourne, 1935, 36 : 310-1.

The results of tests for scald in Western Australia are summarized here. Two sizes (diameter $2\frac{1}{2} \times 2\frac{3}{4}$ ") of Granny Smith apples were subjected to four treatments after picking. In two cases they were packed, and stored immediately, one lot in oil wraps and the other in grease-proof papers. The other two were held unwrapped in a shed for 17 days, and were then packed as before, the same two wrappers being used. This was repeated five times using fruit picked at weekly intervals from April 6th to May 4th. In each instance the unit was one case. After about 5 months all apples were examined and graded on the degree of scald. As a result four conclusions could be drawn. 1. The use of the more expensive grease-proof paper was of no advantage at any time and appeared distinctly detrimental for the early pickings. 2. In the early pickings the larger apples tended to produce more scald ; later there was no difference. 3. Early picking and delayed storage gave less scald than early picking and immediate storage. 4. Early picking and delayed storage would appear to be better than a later intermediate picking and immediate storage, but on the whole later picked apples showed less scald. Taking the market requirement of green colour into consideration, however, the later fruits were too yellow, especially when storage was delayed ; and it is therefore suggested that the third picking, April 20th, would be best, when combined with a delay of at least 3 weeks before storage, if apples are required for the very late market.

* *Ann. appl. Biol.*, 1931, 18 : 60-74.

496. KIDD, F., AND WEST, C.

664.85.11.037

Storage of apples.*Apples and pears: varieties and cultivation in 1934, 1935*, pp. 167-75, Roy. hort. Soc., London, 7s. 6d.

The authors in this brief paper deal mainly with the influence of temperature, atmospheric humidity and atmospheric composition in the cold store. The temperatures and atmospheres recommended for the storage of 8 culinary and 6 dessert varieties of apple in this country are tabulated. Optimum temperatures for the storage of these vary appreciably from 34° F. in the case of Ellison's Orange to 40° F. in that of Laxton's Superb. Again Blenheim Orange is kept best in a storage atmosphere containing no CO₂, Laxton's Superb in an atmosphere containing 10% CO₂. It is noted that in addition to prolonging the storage life of the fruit gas storage also retards changes in ground colour from green to yellow, a great advantage in the case of culinary varieties. It is also found to provide an almost complete control of injury due to surface-eating Tortrix larvae.

497. KIDD, F., AND WEST, C.

664.85.11.035.1

The refrigerated gas storage of apples.*Food Investigation Leaflet 6.11*, 1935, pp. 12, bibl. 7.

The term refrigerated gas storage is used to describe a method whereby the composition of the atmosphere (oxygen and carbon dioxide) and the temperature are regulated in a gas-tight chamber in which apples are stored. *Advantages of gas storage.* The life of the fruit is prolonged to practically twice the normal, the ripening process being slowed down to half what it would be at a corresponding temperature in air. Low temperature breakdown, a serious disease, is avoided because the temperatures used in gas storage are above those at which breakdown will develop. The change from green to yellow in the fruit is retarded (important in marketing cooking apples) and the hardness of the fruit is maintained. Tortrix larvae, a source of damage and, indirectly, of fungal infection, are killed. The apples have a long life after removal from store. *Method.* Only clean and sound apples should be used. Apples picked during warm weather should be allowed to stand in the open overnight and should be stored early the next morning. Moisture on the fruit is immaterial. The right degree of maturity is important. Apples that can be detached by gently twisting the fruit on its stem are at the proper stage. If possible not more than two days should elapse between picking and sealing the store. Five days is the absolute maximum. To reduce delay after picking, grading can be postponed till after removal from store. After 3-4 months' storage fruit may be removed weekly, provided the correct temperature is maintained. A chamber holding 30 tons is the smallest economical unit except, perhaps, for a particularly valuable apple such as Cox's Orange Pippin. A 50-ton capacity store, preferably divided into two or more chambers, is more suitable for larger growers. The present method of constructing a gas-proof chamber is to line the roof and walls with tinned or galvanized sheet metal of about 26 s.w.g. The sheets, dressed back and front with anti-corrosive oil, are fastened to wooden grounds, and should have an overlap of about 2 inches. The joints are sealed by inserting some suitable substance such as vaseline before fastening. Sealing preparations are now on the market. The cement floor is sealed with a proprietary composition that forms a firm smooth surface that can be easily cleaned. The door is made of metal-covered 3-ply wood, in two or more vertical sections, screwed down to wooden door frames and the joints sealed. A leakage of at least 6 per cent. of the volume of gas per day appears to be unavoidable and unimportant. The lee of some shelter should be chosen for the site as strong winds may cause serious loss of gas. The foundations must be firm to avoid any leakage through subsidence. The principal gases to be controlled are oxygen and carbon dioxide, the latter being produced from the former by the respiration of the fruit, volume for volume. The correct concentrations of oxygen and carbon dioxide can in some fruits such as Bramley's Seedling be produced by allowing the fruit to replace oxygen in the air by carbon dioxide and regulating any excess of the latter by the admission of air. The percentage of carbon dioxide is measured by means of a katharometer. Instructions for fitting this are given. Air is admitted by means of an adjustable port 1 ft. sq. in the door. This also enables fruit to be seen and

samples withdrawn. If the cooling is by forced circulation of air over a battery of cold pipes adequate ventilation is provided by means of a $\frac{1}{4}$ bore pipe opening on the suction side of the fan. Regulated ventilation can only control carbon dioxide when the concentration of this gas and oxygen add up to 21 per cent. of the atmosphere in the chamber. (The remaining 79 per cent. is nitrogen.) To obtain other combinations, e.g. 5 per cent. oxygen + 5 per cent. carbon dioxide, without admitting excess oxygen through ventilation, the excess carbon dioxide must be absorbed within the chamber. The methods of independent control of oxygen and carbon dioxide are now being studied. Humidity in the gas store should be maintained at 85-98 per cent. of saturation. In this connection the great capacity of wooden boxes for absorbing moisture is mentioned. The store boxes should always be thoroughly damp when apples are packed. Volatile substances given off by ripening apples cause much damage in gas storage especially to unripe fruit. To prevent this all apples should be wrapped in oiled paper and varieties with different times of ripening should not be stored together. Methods of cooling are discussed. Insulation of the store is not necessary if the walls are thick (18 in.) except in the roof. In new stores packed, double wooden walls are erected inside a weather-proof shell. Storage boxes should be uniform and used for no other purpose. The method of stacking to provide adequate air circulation is described. Three distant-reading thermometers are required in a 50-ton chamber. These are placed at different points among the fruit. The point is stressed that it is the temperature of the fruit and not of the air which has to be controlled. The appendices give tables of temperatures and atmospheres recommended for the storage of various home-grown apples and an estimate of the cost of gas storage. For 4-chambered stores of 200 tons total capacity the inclusive capital cost for new construction, assuming main electricity is available, is £15 per ton or £17 10s., if a Diesel engine is required. A 12-chambered store of 600 tons total capacity would cost £13 15s. or £15 per ton. This includes cost of out-building ($\frac{1}{3}$ of total) which houses the chambers and provides room for packing and grading. The running costs should amount to 1s. per bushel for 6 months' storage.

498. EAVES, C. A. 664.85.7.035.1
The present status of gas storage research with particular reference to studies conducted in Great Britain and preliminary trials undertaken at the Central Experimental Farm, Canada.
Sci. Agric., 1935, 15 : 542-55, bibl. 30.

The paper opens with a resumé of the work of Dr. Kidd and Dr. West of the Food Investigation Board of Great Britain. An account of several preliminary trials in Canada with strawberries and raspberries follows. Initial troubles connected with the circulation of gas and the prevention of leakage are mentioned. The difficulty of controlling mould development by using high concentration of either nitrogen or carbon dioxide without causing loss of flavour or the production of bitterness is emphasized. In the case of raspberries the best results were obtained by storing the fruit at 32° F. in atmospheres containing 5% CO₂.

499. LLOYD, J. W., AND DECKER, S. W. 664.85.11.037
Factors influencing the refrigeration of packages of apples.
Bull. Ill. agric. Exp. Sta., 410, 1934, pp. 15-50, bibl. 14.

The refrigeration equipment used for the experiments described here was designed as nearly as possible to provide identical conditions to those found within a refrigerator car. The temperature and air velocity could, however, be controlled and varied at will. The apples used throughout were of the variety Grimes. The temperature in the cooler was kept as nearly as possible at 35° F. To test rates of cooling medium-sized, graded fruits were packed in the straight-sided tub bushel basket with ventilated paper liner and corrugated paper facing pad which is the standard container in the central states. Fruit temperatures were recorded by thermocouples placed in the centres of four individual fruits in each of the three rings which this method of packing provided. In the cooling chamber it was found that comparatively large temperature gradients developed between the outer and inner rings, but that later the temperatures became more uniform throughout the packages. In an attempt to determine the means by which

cooling in the centre of the package was induced additional temperatures were recorded for the air spaces between the fruits of the two outer rings of fruit. Air temperatures were found to lie about midway between the fruit temperatures at all stages of cooling, thus appearing to indicate that air circulation was of little importance. When, however, air spaces were filled with mineral wool the cooling period necessary for the inner fruits was doubled. Further tests were conducted to determine the effect of forced air circulation on rate of cooling. Fruits packed as before were subjected to air velocities of 88.4, 114.4 and 156.2 feet per minute. Only the higher velocity (156 f.p.m.) induced appreciably quicker cooling than a control placed in still air. In this connection it is interesting to note that air velocities in refrigerator cars rarely exceed 80 f.p.m. Continuing the trials it was found that apples put into the cooler at higher temperatures cooled more rapidly than did fruits at lower temperatures and after a time a common level was reached. Size of fruit had no apparent effect. A comparison of the effect and rate of cooling of various containers showed that the contents of a ventilated corrugated bushel box and a bushel hamper behaved in a similar manner to the lined tub bushel. An unventilated corrugated bushel box and a lined western apple box induced slower cooling, and a wire-bound slat crate much more rapid cooling than the lined tub. The use of oil paper wraps on the apples materially reduced the rate of cooling.

500. ESBJERG, N. 664.85.22.037
 Forsøg med Opbevaring af Blommer i Kølerum og i Kældere. (**Storing of plums in cold storage and in common cellar.**)
Tidsskr. Planteavl., 1934, 40 : 616-7.

Plums and prunes grown at Blangsted kept well for 3-4 weeks in cold storage at 1° C., but in a common cellar at 11-12° C. fruit from the same lots only kept in good condition a few days.
 N.E.

501. ESBJERG, N. 664.85.75.037
 Afkøling af Jordbaer. (**Precooling and cold storage of strawberries.**)
Tidsskr. Planteavl., 1934, 40 : 636-8.

Precooling has made it possible to forward strawberries from Blangsted to the most distant part of the country in good condition. In trials made in 1930, 1931 and 1932 the varieties Dybdahl and Spangsbjerg 5 kept well when stored in a temperature ranging from 2.5°-4° C. for 6 days.
 N.E.

502. WILLIAMS, W. J. 664.85.31.037
Cool storing oranges.
Hadar, 1935, 8 : 145-6. [Abstracted from *The Citrus News*, Feb., 1935.]

Precooling before shipping is advocated because the rate of cooling in a ship's hold is much slower than in a cooler. Even then with an outside temperature of 80° F. oranges placed in a cooler at 38° F. took 72 hours to attain a temperature of 40° F. Experiments indicated on all occasions that oranges stored well at 38-40° F. at a humidity of 84%. Below 38° F. brown spotting of the skin may occur and above 40° F. blue mould may develop, especially if the humidity rises above 84%. In the case of Thompson Navel oranges wrapped fruits kept better than unwrapped, and those wrapped in sulphite tissue kept better than fruits wrapped in waxed papers.

503. GARY, W. Y. 664.85.31.037 : 632.111
The effect of freezing on oranges.
Citrus Ind., 1935, 16 : 5 : 3, 22.

In order to find a better method of assessing the extent of damage done to oranges by freezing, tests were conducted using artificially chilled and frozen fruit. Samples were analysed at intervals after thawing had commenced. The analysis of chilled fruits did not differ materially from fruits kept at normal temperatures. Frozen oranges, however, were characterized by white specks of hesperidin in the pulp, by lighter colour of the pulp, by "mushiness" due to

breakdown of cell walls, and darker surface to the peels. Rotting began six days after thawing. Juice from frozen oranges formed a less compact sediment, and after some days this sediment tended to float. Freezing produced an abnormal loss of juice, which became progressively more marked with lapse of time after thawing. Citric acid dropped after thawing, the pH value in general corresponding. Total sugars remained virtually unchanged by freezing but invert sugars increased at the expense of sucrose. Total soluble solids remained the same and the vitamin C content was not reduced. Frozen oranges do not seem to have any detrimental effect on persons eating them. The author considers that the basis of any test as to fitness for marketing should be the proportion of juice present. Oranges with less than 43% are unduly dry, but fruits only slightly frozen with higher percentages of juice than this could be marketed satisfactorily.

504. BENTON, R. J. 664.85.31 : 632.4
Storage wastage of Valencia oranges.
Agric. Gaz. N.S.W., 1935, 46 : 389-93.

A total of 320 bushel cases of Valencia oranges, subjected to 8 different treatments, were held in store to determine the effect of each treatment upon three types of rot, namely *Penicillium* moulds, stem-end rots, and sore-eye or stem-end browning. In each treatment except the control the fruits were immersed twice, the second sterilizer being different from the first in each case. The temperature in all cases was 110° F. These oranges were then packed, and three-fifths of the total consignment were placed in cold storage at 40° F. for 8 weeks, the remainder going into ordinary store for 5 weeks. At the end of these two periods all the fruits were examined. One treatment consistently gave the best results for all three types of rots. This was an immersion in a 1% alkaline cleansing substance (proprietary) for 2 minutes followed by an immersion in 3% borax for 5 minutes. Sore-eye did not develop at all on fruits held in ordinary storage for 5 weeks, but averaged over 19% infection in fruit held in cold store for 8 weeks. Three treatments in which borax figured gave appreciable and significant control of sore-eye, and borax was again prominent in controlling stem-end rot. Owing to dry weather, however, very little blue and green mould developed, and the effects of the treatments on these rots are therefore not recorded.

505. ELZE, D. L. 634.31-2.4
Some experiments on the combined effect of *Diplodia* and green mould inoculations on oranges.
Repr. Hadar, 1934, 7 : 223-5.

Experiments were carried out on boxed oranges with *Diplodia natalensis* Evans and *Penicillium digitatum* Sacc. They show that these fungi when inoculated at the same time in one fruit will influence one another, and that in such cases one will appear at an earlier date than it would, if inoculated separately in different fruits. When *Penicillium* is present in an orange in a latent state, a later inoculation with *Diplodia* may cause the *Penicillium* to spread rapidly and dangerously. It is considered as most probable that oranges from trees infected with *Diplodia* will be more liable to trouble from *Penicillium* than those from healthy trees.

506. LE ROUX, J. C. 634.3-1.547.6 : 547.313.2
Colouring fruit artificially.*
Fmg. S. Afr., 1935, 10 : 238.

Treatment with ethylene or acetylene may be of great advantage in colouring fruits in which normal internal development to full ripeness precedes external colouring. Thus ripe Navel and mid-season oranges may be put on the market a fortnight earlier if artificially coloured. Likewise Valencias still on the trees at the end of the season tend to become green again at the stem end, and these too may be coloured to advantage. Furthermore such treatment may reduce

* See also Marloth, R. H., Ethylene colouring and ripening of fruits and vegetables, *Ibidem* 1933, 8 : 17-18, 21, *H.A.*, 1933, 3 : 1 : 128.

certain insect pests, such as false codling moth and fruit fly, and also some diseases such as bacterial spot on mangoes. In the case of oranges, however, the fruit must be fully developed and internally ripe. Mangoes or tomatoes should also be fully developed, and almost normally ripe.

507. HERRERO, M., AND ACERETE, A. 634.31 : 547.313.2
 Ensayos de coloración de naranjas por medio del gas etileno. (**Attempts to colour oranges with ethylene gas.**) [English summary.]
Bol. Inst. Invest. agron. Madrid, 1935, 1 : 49-64, bibl. 4.

Treatment with ethylene was found to change the colour of the fruit without affecting the sugar : acid ratio to any marked extent. The best temperature conditions were found to be between 18° and 20° C., humidity between 80% and 85%, gas concentration 2 per 1,000, ventilation every 8 hours. Experiments are being continued to discover to what varieties the process can most profitably be applied, taking into due consideration the actual dates of their internal ripening.

PACKING, PROCESSING, FRUIT PRODUCTS.

508. MINISTRY OF AGRICULTURE, LONDON. 631.564 : 634.1/7 + 635.1/7
List of authorized packers and registered distributors in the national mark schemes for fresh fruit and vegetables.
Marketing Leaf. Minist. Agric., London, 57a, 1935, pp. 48.

The list is revised up to May, 1935. It is interesting as an index of progressive fruit and vegetable growers in particular districts, and is useful to distributors of National Mark produce who find their supplies of such produce inadequate.

509. STEWART, R. M. 546.27 : 664.85.3
Interesting new uses of soluble borates in the packing houses.
Citrus Ind., 1935, 16 : 5 : 7, 22.

It has been known for some time that citrus fruits dipped in a 3-5% borax solution were rendered practically immune to green and blue moulds. Recent tests at Orlando have indicated that a concentration of about 8% is highly effective in controlling stem-end rot, but owing to the low solubility of borax in cold water it is necessary to maintain the solution at 100-110° F. Attempts are now being made to find more easily soluble borates, and proprietary materials are now on the market which are claimed to fulfil these requirements.

510. GILL, H. C. 664.85
The fruit canning industry of the Empire. An economic survey II and III.
Food, 1935, 4 : 326-8, 405-8.

Part I* surveyed the fruit canning industry of the U.K. Parts II and III are concerned with Australia. Fruit production for the industry is centred in the south-eastern portion of the continent, Victoria and New South Wales supplying 90 per cent. of the total pack, principally apricots, peaches and pears. Queensland is concerned chiefly with pineapples. Since the formation in 1926 of the Australian Canned Fruits Board composed of growers and canners with an independent chairman and the Government's blessing the export of canned fruits of the above varieties has risen from 295,663 cases in 1926 to 923,475 cases in 1934, 90.5 per cent. of which are taken by the U.K. In addition in 1934, 504,042 cases were used in home consumption. Chief competition in the U.K. with Australian canned fruit comes from California. Australian canned fruit, however, enjoys a tariff preference of 15% *ad valorem* plus a rebate of 50% of the duty paid in the sugar content of the canning syrup. Prices show a tendency to decline but the fruits always maintain the same order, e.g. pears always fetch a better price than apricots and apricots than peaches. The Queensland canned pineapple is recognized to be

* Part I, *Ibid.*, pp. 268-70. *H.A.*, 1935, 5 : 2 : 311.

of the finest quality, but suffers on the market from the competition with Malayan pine, which though of inferior quality is very much cheaper on account of low cost of labour. The export to all countries in 1925-6 totalled 27,664 lb., by 1933-4 this had increased to 4,493,298 lb., nearly all of which was taken by the U.K. and Canada. The principal variety of canning pine grown is the smooth-leaf Cayenne, which has large, well-flavoured fruits weighing from 7-10 lb. each. All other fruits than those mentioned are only exported in small quantities. The majority of them, such as loganberries and blackberries, come into competition with the canned fruit produced in the U.K. but have little effect on the market. The article concludes with a plea for some form of co-operation between home and overseas Empire producers and instances the success achieved for the Australian industry by the efforts of the Australian Canned Fruits Board.

511. FERGUSON, W.

663.3

Cider as a fruit product.

Sci. Agric., 1935, 15 : 557-63.

The possibility of converting low grade apples into cider is discussed, showing how the grower will benefit not only from the sale of such apples but also by removing them from competition with higher quality fruit. After showing briefly how cider production has developed in England and the development of cider varieties, the author points out that such varieties need not be developed here (in Canada) because many of our common apples when blended properly with juices of some crab apple varieties make an excellently flavoured beverage. A short description of various methods of cider making is given with a more detailed account of the Closed Cuvee Process as developed at the Fruit Products Laboratory, Central Experimental Farm, Ottawa. In conclusion the author discusses such troubles as arrested fermentation, blackening and greening, sedimentation, " casse ", and lack of sterility. [Author's summary.]

512. CHARLEY, V. L. S.

663.3

The rôle of pectin in cider-making processes. I. Introduction and historical.

II. Pectin changes associated with maceration and fermentation and the effects of the addition of pectin solutions to dry ciders.

Annu. Rep. Long Ashton Res. Sta. for 1934, 1935, pp. 217-45, bibl. 17.

Part I gives an account of the relevant research work, dealing chiefly with pectin studies in wine making. Part II. Apple juices macerated with once pressed pomace dissolve considerable quantities of soluble pectin. The favourable changes made in ciders by this process cannot be correlated directly with pectin data, as the soluble pectin is removed during fermentation. Sterile pasteurized apple juices fermented separately with 10 different pure yeasts showed no loss of pectin over a 50-day period while similarly inoculated Seitz-filtered but unpasteurized samples lost 60 per cent. of their pectin. This could be explained by the assumption that neither the chemical constituents of the juice nor the yeasts nor their associated enzymes were capable, in this case, of disintegrating the pectin molecule. Possibly, however, the pectin had been decomposed into pectic acid and methyl alcohol, in which case the pectic acid would be included in the calcium pectate figure. That the total soluble pectic materials are not reduced in the pasteurized series is the only interpretation that can justifiably be made from the data. The amount of decomposition in the Seitz-filtered samples varied with the yeast used. Assuming that pure yeasts do not affect pectin under any conditions, the decomposition of pectins in the Seitz-filtered series must be due to enzymes or acids natural to the juice which would not be removed by the filter. But as all samples for treatment were taken from exactly the same well-mixed bulk the decomposition of pectin from this cause should be uniform. Possibly by analogy with the enzyme and co-enzyme relationship which exists in bakers' and brewers' yeasts the yeasts contain agents which are capable of removing pectin only when some accessory factor is present, and this factor is removed by pasteurizing but not by filtering. Should this be so, then in view of their differing rates of decomposition different yeasts must be considered to possess their own specific power of hydrolysing the pectins. The sweetening of dry ciders was

attempted by the addition of pectin solutions in the form of cold and hot water pomace extracts and citrus pectin. No pectin was found after a few weeks in bottle. There were certain changes of flavour which are discussed.

513. CHARLEY, V. L. S. 664.85.035.5
Preservation of fruit with sulphur dioxide. Effect of hot and cold methods on residual SO_2 content of jam.

Annu. Rep. Long Ashton Res. Sta. for 1934, 1935, pp. 255-63, bibl. 4.

The effect of various pulping treatments of plums on the residual SO_2 content of the jam prepared from the pulps has been studied. Plums processed in the cold with 1,000 and 2,000 p.p.m. of SO_2 gave jams which contained 20 and 70 p.p.m. of SO_2 respectively. With this process the use of calcium bisulphite resulted in a lower residual figure, but the data with potassium metabisulphite indicated no significant deviation from the ordinary sulphurous acid method. A considerable increase in residual SO_2 (84-126 p.p.m.) was observed in jams made from hot processed pulps. The skins of the whole fruit preserved in the cold by the stronger solution became toughened and this condition persisted in the jam. The hot processed pulp yielded darker jams in which the fruit was completely disintegrated. Much higher amounts of residual SO_2 remained in the jams. The stones of cold processed plums were found to contain much more SO_2 than the skins and flesh. [Author's summary.]

514. CHARLEY, V. L. S. 663.3
Investigations on fruit products. IV. Experiments on the clarification of unfermented and fermented apple juice.

Annu. Rep. Long Ashton Res. Sta. for 1934, 1935, pp. 246-54, bibl. 1.

Experiments are described on the clarification of cull apple juices by enzymic action and gelatin + tannin treatment. Pectin decomposing enzymes had considerable effects on the ease of filtration of the juice. These were shown to be more important than differences in clarity in the stored juices or ciders caused by the enzymes. A proteolytic enzyme gave remarkably good results with mixed cull apple juice, but with juice of the variety Annie Elisabeth no such effects were obtained. No outstanding differences due to the treatments were observed in the samples which had been bottled for 15 months. The clarification of apple juice, later fermented into cider, was studied by using four enzymic treatments on five different apple juices. Considerable removal of pectin occurred, but this was not always followed by any appreciable clarification of the juice. Filtration after 24 hours was, however, carried out with much greater speed and economy when compared with juices which had not been treated with such enzymes. No significant differences were observed in the filtered samples. [Author's summary.]

515. PICKFORD, P. T. H. 663.3
Containers for apple juice and cider. I. Wooden vessels. A. The suitability of various coniferous woods. 1.

Annu. Rep. Long Ashton Res. Sta. for 1934, 1935, pp. 213-16.

The object of the investigations, which will be carried on as circumstances (mainly financial) permit, is to test the suitability of various containers which are within the means of smaller cider making businesses and of farmers. Wood has been selected as the material for the first investigations because it is always used in some form in cider making operations and because many inquiries have been received at Long Ashton as to the suitability of various woods, particularly coniferous, for the purpose. Hitherto oak and chestnut, preferably the former, have always been used. Only such woods as conform to the necessary standards of length, width, thickness, freedom from defects and are of economic price will be considered. In 1934 preliminary tests were made. Two pieces of each wood $4\frac{1}{2}'' \times \frac{1}{4}'' \times \frac{1}{4}''$ were immersed in pint bottles of 4 types of cider. Each treatment was quadruplicated with controls in each case. The treated ciders were stored in a cool place and examined after 6 months. One cider (bitter-sweet) developed ropiness and so became useless for the test. *Prime Clear Columbian Pine* gave an unpleasant pinewood flavour. *Siberian Red Fir* (Redwood) gave a strong pine flavour to

the blended cider and a less pronounced taste to the sharp and sweet ciders. *Archangel White Fir* gave a harsh bitter flavour. *Louisiana Red Cypress* altered the flavour slightly and left a woody taste on the palate, but its effects were the least objectionable of all. The suggestion is made that, if some treatment can be devised to remove the woody flavour, Archangel White Fir and Louisiana Red Cypress might prove serviceable.

NOTES ON BOOKS, CONFERENCES.

516. BRITISH MYCOLOGICAL SOCIETY.* 632.1 + 632.3/4 + 632.8

List of common names of British plant diseases.

Cambridge Univ. Press, Fetter Lane, London, pp. 95, 2s. 6d.

This small, thin volume will be extremely valuable to all workers on plant diseases. The fact that the common foreign names used in the U.S.A., France, Italy, Germany, Holland and Denmark are also given increases its value tremendously and should spare students of foreign work a great deal of valuable time, which is apt to be wasted in reading literature where only the local names appear. For the practical mycologist to refer to diseases by their local names even when writing scientific papers appears to be a common habit in all countries. This work at least minimizes the resulting confusion.

517. XIth INTERNATIONAL HORTICULTURAL CONGRESS. 634/635

National and general reports presented at the XIth Int. Hort. Congress, Rome, Italy, Sept. 16th-21st, 1935.

In preparation for this conference the field of enquiry had been divided into 10 sections and in each of these sections one or more particular lines of inquiry had been included. Separate reports were received from national reporters by a so-called general reporter whose duty was to present a general report embodying the chief features of the particular reports. At the meetings held to discuss the various themes the general reporter made his report verbally and the theme was then open to general discussion. A number of resolutions were recommended at the sectional meetings and these resolutions were adopted en bloc at the final general meeting. Reports vary in length from some 700 words upwards, the average being about 2,000 words. They are mainly in French or German, a few being in English, Italian or Spanish. They will be printed in full in the proceedings of the Congress together with the resolutions referred to above. In many cases they form a useful source of information and their collection into one volume should add to their value. It is hoped to abstract those few which admit of the process in the next number of *Horticultural Abstracts*. The following notes indicate their subject matter. Section I, theme 1. *Fruit growing in different countries*. National reports were received from the following lands:—Algiers, Belgium, Bulgaria, Czechoslovakia, Denmark, Estonia, France, Germany, Holland, Hungary, Morocco, New South Wales, New Zealand, Poland, Rumania, Union of South Africa, Sweden, Switzerland, Tunis, U.S.A. Other special reports dealt with fruit pollination in New South Wales, pollination in Belgium,—artificial culture of isolated embryos of tree fruits,—methods of attaining uniform crops,—citrus, apricot, fig and almond growing in Italy,—walnut growing in Rumania,—pome and stone fruit growing in Italy,—Nile flood effects on cropping of Japanese plums,—the almond in Eastern Spain. Section I, theme 2. *Horticulture, i.e. market gardening, in different countries*. Reports were received from:—Cuba, Egypt, England, France, Finland, Germany, Holland, Italy, Morocco, New Zealand, Rumania, Spain, Switzerland, Uruguay. Section II, theme 3. *Flower growing*. Reports were received on the following subjects:—Artificially induced mutations in *Petunia hybrida*,—increasing the size of flowers in *Petunia hybrida*,—floriculture in the U.S.A. (2),—research in ornamental horticulture in the U.S.A.,—organization of horticulture in

* Plant Pathology Committee of.

Switzerland—ornamental gardening in Germany,—flower growing in England,—in Bulgaria—in Egypt—in France—in Italy—in Morocco—in Rumania,—the Leyden Botanic Garden,—the German contribution to the production of the modern gladiolus. Section III, theme 4. *Nomenclature, cataloguing of varieties, protection of new discoveries.* Reports were received from Australia, Denmark, England, Finland, France, Holland, Italy, New Zealand, Norway, Poland, Spain, Union of S. Africa, Switzerland, U.S.A., Yugoslavia. Section III, theme 5. *Horticultural education.* Reports from Australia, Denmark, Esthonia, France, Germany, Holland, Italy, Poland, U.S.A. (3), Uruguay. Section III, theme 6. *Manuring of fruit and vegetables.* Reports from Bulgaria, Denmark, Germany, Holland, Italy, New Zealand, Sweden. Section IV, theme 7. *Horticulture in the tropics.* Reports were received on general horticulture or particular aspects of horticulture in the following places :—Algiers, Australia, Dutch East Indies, Egypt, Indochina (4), Italy, Morocco, Union of South Africa, U.S.A. Section V, theme 8. *Pests and means of control.* Reports from Algiers, Australia, Austria, Belgium, Bulgaria, Egypt, Esthonia, France, Hungary, Italy, Poland, Portugal, Rumania, Sweden, Switzerland, Tunis, Union of South Africa, U.S.A., Yugoslavia. Section V, theme 9. *Diseases and means of control.* Reports from Algiers, Bulgaria, Egypt, France, Germany, Holland, Italy, Poland, Switzerland, Tunis, Union of South Africa, U.S.A., Yugoslavia. Section VI, theme 10. *Storage, packing and processing of horticultural products.* Reports received from Algiers, Austria, Denmark, Egypt, France, Germany, Holland, Italy, Morocco, Sweden, Switzerland, U.S.A., Uruguay. Section VII, theme 11. *The rôle of fruits and vegetables in dietetics.* Reports from Bulgaria, Denmark, Finland, Germany, Holland, Hungary, Italy, Union of South Africa. Section VIII, theme 12. *Interchange of plants or parts of plants and of horticultural produce between different countries.* Most of the reports here deal briefly with economic aspects such as tariffs, the use of quarantine regulations, etc. They come from :—Canada, Denmark, France, Germany, Hungary (5), Italy, Poland, Union of South Africa. Section IX, theme 13. *Trade in plants and seeds.* This like the preceding theme was variously interpreted. Reports from Denmark, Finland, Germany, Italy, New Zealand (fruit marketing), Poland. Section X, theme 14. *Economic aspects of flower growing in Italy.* One report only.